United States Environmental Protection Agency

Office of Pollution Prevention and Toxics
Washington, DC 20460

October 1997
EPA 745-B-97-011

EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT SECTION 313

GUIDANCE FOR METAL MINING FACILITIES

(Version 1.0)

CONTENTS

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October 6, 1997

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INTRODUCTION

This guidance document has been prepared to assist metal mining facilities in complying with the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA, Public Law 99-499, Title III of the Superfund Amendments and Reauthorization Act of 1986, hereafter EPCRA Section 313) and Section 6607 of the Pollution Prevention Act (PPA). This guidance document is intended for use along with the Toxic Chemical Release Inventory Reporting Form R and Instructions document published annually by the U.S. Environmental Protection Agency (EPA). For further assistance and to obtain copies of the latest version of this instruction document, contact the EPCRA Hotline at 1-800-535-0202. The other EPCRA reporting programs are summarized at the end of this section.

One of the primary goals of the EPCRA program is to increase the public's knowledge of, and access to, information on both the presence of Section 313 chemicals in their communities and on releases and other waste management activities of Section 313 chemicals into the environment. Since 1987, certain facilities in the manufacturing sector have been reporting information on releases and other waste management activities of Section 313 chemicals to EPA and states throughout the United States. As a result of an EPA rulemaking (62 FR 23834, May 1, 1997), certain additional industry groups, including metal mining facilities (Standard Industrial Classification (SIC) Major Group 10, except 1011, 1081, and 1094) are now required to evaluate their chemical use and management activities to determine potential reporting responsibilities under EPCRA Section 313.

Section 313 establishes annual reporting requirements for Section 313 chemicals provided that certain activity thresholds are met. Section 313 includes a list of over 650 chemicals and chemical categories. These chemicals and chemical categories were either originally selected by Congress or were added by EPA through rulemaking.

The Section 313 reporting requirements apply to owners or operators of facilities which meet all of the following three criteria:

- The facility must be in SIC code **10 (except 1011, 1081, and 1094)**, or 12 (except 1241), or 20-39 (manufacturing facilities), or 4911 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce), 4931 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce) and 4939 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce), or 4953 (limited to facilities regulated under RCRA subtitle C), or 5169, or 5171, or 7389 (limited to facilities primarily engaged in solvent recovery services on a contract or fee basis); and,

- The facility must have 10 or more full-time employees (or the total hours worked by all employees is greater than 20,000 hours), and

- The facility manufactures (defined to include importing), processes, or otherwise uses any Section 313 chemical in quantities greater than the established threshold in the course of a calendar year.

For each Section 313 chemical or chemical category, covered facilities must report the total annual releases, both routine and accidental, to all environmental media; and other on-site waste management activities, including quantities recycled, combusted for energy recovery and treated for destruction, and off-site transfers for disposal, waste treatment, energy recovery and recycling. This information is submitted on the Toxic Chemical Release Inventory (TRI) Reporting Form, which is called the "Form R." (As discussed in the following chapter, facilities meeting certain conditions are eligible to report using an abbreviated Form A.)

The annual Form R or Form A reports are submitted to EPA headquarters and to a state designated agency, usually a State Emergency Response Commission (SERC), or in some cases a Tribal Emergency Response Commission (TERC), annually on or before July 1st for activities occurring during the previous calendar year (e.g., July 1, 1999, for activities during the period from January 1 to December 31, 1998).

EPCRA mandated that EPA establish and maintain a national TRI database to assist in research and the development of regulations, guidelines, and standards related to Section 313 chemicals and to make the TRI data available to the general public and any interested parties. The TRI database is computer-accessible to anyone with a modem via the National Library of Medicine's TOXNET on-line system. The TRI data are also available through many other sources, including EPA's Internet Web site; public libraries on microfiche; the Government Printing Office on CD-ROM; and the National Technical Information Service on magnetic tape and individual state diskettes.

Facility owners or operators who violate the Section 313 reporting provisions may be assessed civil penalties of up to $25,000 per day for each violation. In addition, state enforcement provisions may also be applicable depending on the state's EPCRA Section 313 reporting regulations.

This document is organized into several sections to provide quick reference. Section 2 presents an overview of the Section 313 reporting requirements. Section 3 provides a detailed discussion of how to make threshold determinations regarding the manufacture, processing, and otherwise use of Section 313 chemicals. Section 4 covers general concepts relating to reporting and release estimating, and provides potential data sources for determining releases at metal mining facilities and other amounts managed. Section 5 presents a detailed discussion of EPCRA Section 313

release and other waste management scenarios in the metal mining industry and covers developing estimates of releases and other waste management activities for several types of operations commonly encountered by the metal mining industry. Finally, Appendix A provides an alphabetical listing of the Section 313 chemicals and chemical categories subject to EPCRA Section 313, the *de minimis* concentrations for each Section 313 chemical, and the RCRA status of the chemical. Appendix B provides a table listing the efficiencies of RCRA treatment technologies. Appendix C provides a bibliography of relevant EPA documents used to help metal mining facilities in complying with EPCRA Section 313.

Table 1-1. Summary of Reporting Requirements Under EPCRA

EPCRA Section	Reporting Requirements
Sections 302 - 303 Presence of Extremely Hazardous Substances (40 CFR §355.30)	If a facility has one or more "extremely hazardous substances" present on site in quantities greater than Threshold Planning Quantities (TPQs) established by EPA, it must notify its State Emergency Response Commission (SERC) and Local Emergency Planning Committee (LEPC) that it is subject to the emergency planning requirements of these sections. A facility representative must be designated to participate in the local emergency planning process. The facility also must provide any information deemed necessary for development or implementation of a local emergency plan.
Section 304 Emergency Notification (40 CFR §355.40)	A facility must notify the LEPC and SERC immediately of the release of any "extremely hazardous substance" (listed in 40 CFR Part 355, Appendices A and B) or any hazardous substance under CERCLA (listed in 40 CFR 302.4), in amounts at or above the specified Reportable Quantities that EPA establishes for each substance. The facility must follow up this initial notification with a written statement providing details of the incident.
Section 311 Material Safety Data Sheet (MSDS) Reporting* (40 CFR §370.21)	A facility must submit to the LEPC, SERC, and local fire department a list of Material Safety Data Sheets (MSDSs), or copies of MSDSs, for any "hazardous chemicals" (as defined under the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard) that are present on site in quantities greater than 10,000 pounds. A facility also must report any "extremely hazardous substances" (EHS) (as defined under Section 302) that are present on site in quantities at or above the TPQ or 500 pounds, whichever is less. Submissions are required within 90 days of the date when new chemicals are first present at or above specified thresholds or if new information on previously reported chemicals becomes available. Some states have established lower activity thresholds.
Section 312 Hazardous Chemical Inventory* (40 CFR §370.25)	A facility must submit to the LEPC, SERC, and local fire department certain information for any "hazardous chemical" or EHS reportable under Section 311. This information is most commonly submitted on a Tier I or Tier II Form and includes a description of any type of hazard the material may pose, the quantities stored, general storage locations, and type of storage. The reports for each calendar year are due on or before March 1 of the following year. Most states require or request that facilities submit the more detailed Tier II reporting form or a state-issued version of that form. In addition, some states have established lower activity thresholds and require more detailed or additional information.

* Facilities that are not subject to OSHA are not covered by EPCRA Sections 311 or 312.

EPCRA Section	Reporting Requirements
Section 313: Toxic Chemical Release Inventory Reporting (Form R) (40 CFR §372)	A facility in certain SIC codes meeting threshold requirements is required to report annually amounts of listed Section 313 chemicals released or otherwise managed to EPA and designated state agencies. Section 313 includes a list of over 650 chemicals and chemical categories. Release reporting information is submitted on the Toxic Chemical Release Inventory (TRI) Reporting Form, Form R. The Section 313 reporting requirements apply to owners or operators of facilities which meet all of the following three criteria: ■ Facility must be in SIC code **10 (except 1011, 1081, and 1094)**, or 12 (except 1241), or 20-39 (manufacturing facilities), or 4911 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce), 4931 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce) and 4939 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce), or 4953 (limited to facilities regulated under RCRA subtitle C), or 5169, or 5171, or 7389 (limited to facilities primarily engaged in solvent recovery services on a contract or fee basis); and, ■ Facility must have 10 or more full-time employees (or the total hours worked by all employees is greater than 20,000 hours), and ■ Facility must manufacture (including importation), process, or otherwise use a listed Section 313 chemical in excess of specific threshold quantities. The threshold quantities for reporting under Section 313 are based on the amount of the Section 313 chemical manufactured, processed, or otherwise used during the calendar year. Specifically, the thresholds are greater than 25,000 pounds if manufactured, or 25,000 pounds if processed, or 10,000 pounds if otherwise used. EPCRA mandated that EPA establish and maintain a national TRI database to assist in research and the development of regulations, guidelines, and standards related to Section 313 chemicals and to make the TRI data available to the general public and any interested parties. The TRI database is computer-accessible to anyone with a modem via the Internet or the National Library of Medicine's TOXNET on-line system.

SECTION 2
SECTION 313 REPORTING REQUIREMENTS

WHO MUST REPORT?

A facility is subject to the provisions of the Section 313 reporting requirements if it meets all three of the following criteria:

- The facility must be in SIC code **10 (except 1011, 1081, and 1094)**, or 12 (except 1241), or 20-39 (manufacturing facilities), or 4911 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce), 4931 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce) and 4939 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce), or 4953 (limited to facilities regulated under RCRA subtitle C), or 5169, or 5171, or 7389 (limited to facilities primarily engaged in solvent recovery services on a contract or fee basis) hereafter "covered SIC codes"; and,

- Facility must have 10 or more full-time employees (or the total hours worked by all employees is greater than 20,000 hours), and

- The facility manufactures (defined to include importation), or processes, or otherwise uses any Section 313 chemical in quantities greater than the established threshold in the course of a calendar year.

Instructions regarding how to determine the facility SIC code, employee threshold, or activity follows; for additional detail please consult the *Toxic Chemical Release Inventory Reporting Form R and Instructions*, a document published annually by EPA.

In addition, pursuant to Executive Order (EO) 12856 signed by the President on August 3, 1993, Federal facilities are required to determine the applicability of the EPCRA Section 313 reporting requirements regardless of the facility's SIC codes. Federal facilities that have 10 or more full time employees or the equivalent and manufacture, process, or otherwise use listed Section 313 chemicals at or above established thresholds are subject to EPCRA Section 313 reporting. Federal facilities were required to begin reporting no later than reporting year 1994; their first Form R or Form A reports were due by July 1, 1995.

The amount of the chemical released to the environment does not affect the need to report. Even if there are no releases of a listed Section 313 chemical, a facility must report if it meets the

requirements regarding SIC code, number of employees, and activity threshold. A threshold determination must be made individually for each Section 313 chemical.

Thresholds are based on operation year, this includes partial year reporting and reporting by a facility that is going through closure. The facilities should consider the portion of the year for which they operated to determine the actual employee hours worked as well as threshold determination and release reporting.

Reduced Reporting

On November 30, 1994, EPA published a final rule (59 FR 61488) that provides an alternative reporting option to qualifying facilities. Eligible facilities wishing to take advantage of this alternative reporting option may report on a simplified two page form referred to as Form A and do not have to use Form R. The rule entitled "TRI Alternate Threshold for Facilities with Low Annual Reportable Amounts," provides facilities that otherwise meet EPCRA Section 313 activity thresholds the option of reporting on Form A, provided that they do not exceed 500 pounds for the total annual reportable amount (defined below) for that chemical, and that the amounts manufactured, processed or otherwise used do not exceed 1 million pounds. As with determining an activity threshold to determine if the chemical activity has been exceeded, facilities must evaluate each activity threshold separately; for example, a facility that manufactures 900,000 pounds per year of a Section 313 chemical and processes 150,000 pounds per year of a Section 313 chemical would still be eligible to use the Form A.

For the purpose of reporting on Form A, the annual reportable amount is equal to the combined total quantities released (including disposed) at the facility, treated at the facility (as represented by amounts destroyed or converted by treatment processes), recycled at the facility, combusted for the purpose of energy recovery at the facility, and amounts transferred from the facility to off-site locations for the purpose of recycling, energy recovery, treatment, and/or disposal. These quantities do not include amounts of the chemical accidentally released. These volumes correspond to the sum of amounts reported on Form R, as Part II column B of section 8, data elements 8.1 (quantity released), 8.2 (quantity used for energy recovery on-site), 8.3 (quantity used for energy recovery off-site), 8.4 (quantity recycled on-site), 8.5 (quantity recycled off-site), 8.6 (quantity treated on-site), and 8.7 (quantity treated off-site). See Section 4 of this document for more guidance on completing Part II, Section 8 of Form R.

What is a facility?

Under EPCRA, a "facility" is defined as all buildings, equipment, structures, and other stationary items which are located on a single site or contiguous or adjacent sites and which are owned or operated by the same person (or by any person which controls, is controlled by, or under common control with such person). An "establishment" is generally a single physical location,

where business is conducted or where services or industrial operations are performed. A facility may contain more than one establishment. For example, a mine, mill, and smelter would be one facility if all three units were owned and operated by the same company and are located on contiguous or adjacent properties. A single facility therefore can be a multi-establishment complex. Such a facility may submit reports that cover all its establishments, or the individual establishments may report separately. However, for the purposes of determining thresholds, all chemical activities for the entire facility must be considered.

How to Determine Your SIC Code**

Standard Industrial Classification (SIC) codes 10 (except 1011, 1081, and 1094), 12 (except 1241), 20-39 (manufacturing facilities), 4911, 4931 and 4939 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce), 4953 (limited to facilities regulated under RCRA subtitle C), 5169, 5171, and 7389 (limited to facilities primarily engaged in solvent recovery services on a contract or fee basis) are covered under section 313 of EPCRA. The first two digits of a 4-digit SIC code define a major business sector, while the last two digits denote a facility's specialty within the major sector. A facility should determine its own SIC code(s), based on its activities on-site and the "Standard Industrial Classification Manual 1987." In some cases, a state agency or other organization may have assigned SIC codes on a different basis than the one used in the SIC Manual. For the purposes of TRI reporting, state assigned codes should not be used if they differ from ones assigned using the SIC Manual.

Your facility may include multiple establishments that have different SIC codes. In order to determine which SIC code best represents the facility, the facility should calculate the value of the products or services produced or provided at/by or shipped from each establishment within the facility and then use the following rule to determine if your facility comes within the covered SIC codes, and the SIC code criterion is met.

- If the total value of the products or services shipped, produced or provided at establishments in "covered" SIC codes is greater than 50 percent of the value of the entire facility's products and services, the entire facility comes within the covered SIC codes, and the SIC code criterion is met.

- If any one establishment in the specified set of SIC codes produces, provides or ships products or service whose value exceeds the value of products and services produced or

**Please note: The North American Industrial Classification System that appeared in the *Federal Register* on April 9, 1997 will replace the 1987 Standard Industrial Classification System (SIC). Regulatory entities, including EPA, will take steps to adopt the new classification system over the next few years. In the meantime, facilities should consider their activities in relation to the 1987 SIC code system.

shipped by all other establishments within the facility, the facility comes within the covered SIC codes, and the SIC code criterion is met.

The value of production or service attributable to a particular establishment may be isolated by subtracting the product or service value obtained from other establishments within the same facility from the total product or service value of the facility. This procedure eliminates the potential for "double counting" production or service in situations where establishments are engaged in sequential production activities at a single facility.

How to Determine Your Number of Employees

A "full time employee," for the purpose of Section 313 reporting, is defined as 2,000 work hours per year. The number of full time employees is dependent only upon the total number of hours worked by all employees during the calendar year for that facility and not the number of persons working. To determine the number of full time employees working for your facility, add up the hours worked by all employees during the calendar year including contract employees and sales and support staff, and divide the total by 2,000 hours. In other words, if the total number of hours worked by all employees is 20,000 hours or more, your facility meets the ten employee threshold.

Facilities may have contract workers present at times to conduct maintenance and service operations, including equipment, motor vehicle, and building maintenance, construction, and operating processes and waste management activities (e.g., remediation). The hours of all these contract workers count toward the employee threshold for reporting under Section 313. In addition, the hours worked by professionals (e.g., those on salary, that do not clock in or out) also count towards the facility's's employee threshold. Employees that perform activities which routinely occur off-site such as truck drivers, but who are based at the facility are also counted towards the employee threshold. Routine activities performed at the facility by outside personnel such as contract drivers that are not based at the facility are not counted towards the employee threshold.

CHEMICAL ACTIVITY THRESHOLDS

Section 313 requires a facility that meets the SIC code and employee criteria to submit Form R reports for any listed Section 313 chemical or chemical category that it manufactures in annual quantities greater than 25,000 pounds, processes in annual quantities greater than 25,000 pounds, or otherwise uses in annual quantities greater than 10,000 pounds (40 CFR §372.3). These thresholds (manufacture, process, or otherwise use) will be referenced throughout this document as "activity thresholds." Chemicals must be evaluated in association with one or more of these three categories when determining whether an activity threshold has been exceeded. These categories are:

- **Manufacture** - "Manufacture" means to produce, prepare, compound, or import a listed Section 313 chemical. Import is defined as causing the Section 313 chemical to be imported into the customs territory of the United States. If you order a listed Section 313 chemical (or a mixture containing the chemical) from a foreign supplier, then you have imported the chemical when that shipment arrives at your facility directly from a source outside of the United States. By ordering the chemical, you have "caused it to be imported," even though you may have used an import brokerage firm as an agent to obtain the Section 313 chemical. If the importation was directed by the parent company, then the facility receiving the chemical is not considered to have imported the chemical.

  The term manufacture also includes coincidental production of a listed chemical (e.g., as a byproduct or impurity) as a result of the manufacture, processing, otherwise use, or waste management of other chemical substances. The fact that the coincidental manufacturing of these byproducts is not the primary purpose of the facility is irrelevant. Listed EPCRA Section 313 chemicals coincidentally manufactured by a facility must be factored into threshold determinations and release calculations.

- **Manufactured Activities and Definitions**

- Produced or imported for on-site use/processing

  A chemical that is produced or imported and then further processed or otherwise used at the same facility.

  - Produced or imported for sale/distribution

    A chemical that is produced or imported specifically for sale or distribution outside the facility.

  - Produced as a by-product

    A chemical that is produced coincidentally during the production, processing, otherwise use, or disposal of another chemical substance or mixture and, following its production, is separated from that other chemical substance or mixture. Section 313 chemicals produced and released as a result of waste treatment for disposal are also considered byproducts.

  - Produced as an impurity

    A chemical that is produced coincidentally as a result of the manufacture, processing, or otherwise use of another chemical but is not separated and remains primarily in the mixture or product with that other chemical.

- **Process** - "Process" means the preparation of a listed Section 313 chemical, after its manufacture, for distribution in commerce. Processing is usually the intentional incorporation of a Section 313 chemical into a product. Processing includes preparation of the Section 313 chemical in the same physical state or chemical form as that received by your facility, or preparation that produces a change in physical state or chemical form. The term also applies to the processing of a mixture or other trade name product that contains a listed Section 313 chemical as one component. Processing activities include use of Section 313 chemicals as reactants, in formulations, and as article components, and repackaging. Processing may also include the recycling of a Section 313 chemical for distribution in commerce. For example, if a facility receives a waste containing a Section 313 chemical from off-site, stabilizes, and repackages the waste in one calendar year and then distributes the repackaged waste into commerce in the following year. The facility would count the amount of the Section 313 chemical stabilized as being processed in the year it was treated.

  The extraction and subsequent distribution in commerce of ore containing EPCRA Section 313 chemicals constitutes "processing" of those listed chemicals. For the purposes of the processing definition, EPA defines ***extraction*** to mean the physical removal or exposure of ore, coal, minerals, waste rock, or overburden prior to beneficiation, and encompasses all extraction-related activities prior to beneficiation. Extraction does not include beneficiation (including coal preparation) mineral processing, *in situ* leaching or any further activities. (See 40 CFR §372.3.) **Removal of waste rock to gain access to an ore body does not constitute processing and therefore these amounts are not considered toward threshold determinations. Disposal and other releases (e.g., during transport) of TRI chemicals contained in waste rock may be reportable if thresholds are exceeded for the chemical elsewhere at the facility.**

  Relabeling or redistributing of the Section 313 chemical where no repackaging of the Section 313 chemical occurs does not constitute processing of the Section 313 chemical.

- **Processed Activities and Definitions**

  - As a reactant

    A natural or synthetic chemical used in chemical reactions for the manufacture of another chemical substance or product. This includes, but is not limited to, feedstocks, raw materials, intermediates, and initiators.

  - As a formulation component

    A chemical added to a product (or product mixture) prior to further distribution of the product that acts as a performance enhancer during

use of the product. Examples of Section 313 chemicals used in this capacity include, but are not limited to, additives, dyes, reaction diluents, initiators, solvents, inhibitors, emulsifiers, surfactants, lubricants, flame retardants, and rheological modifiers.

- As an article component
  A chemical that becomes an integral component of an article distributed for industrial, trade, or consumer use.
- Repackaging
  Processing or preparation of a Section 313 chemical (or product mixture) for distribution in commerce in a different form, state, or quantity. This includes, but is not limited to, the transfer of material from a bulk container, such as a tank truck, to smaller containers such as cans or bottles.

- **Otherwise use** - Any use involving a listed Section 313 chemical at a facility that does not fall under the definitions of 'manufacture" or "process" is an otherwise use of that chemical. A chemical that is otherwise used by a facility is not incorporated into a product distributed in commerce and includes use of the Section 313 chemical as a chemical processing aid or as a manufacturing aid or for ancillary uses such as treating wastes. Otherwise use of a Section 313 chemical does not include disposal, stabilization (without subsequent distribution in commerce), or treatment for destruction unless:

  (1) The Section 313 chemical that was disposed, stabilized, or treated for destruction was received from off-site for the purposes of further waste management, or

  (2) The Section 313 chemical that was disposed, stabilized, or treated for destruction was manufactured as a result of waste management activities on materials received from off-site for the purpose of further waste management.

  Relabeling or redistributing of the Section 313 chemical where no repackaging of the Section 313 chemical occurs does not constitute the otherwise use of the Section 313 chemical.

  The difference between "processing" and "otherwise use" is important because these activities are subject to different activity thresholds. Because beneficiation of ore is preparation of its constituents, any beneficiation of ore containing Section 313 chemicals (e.g., copper in copper ore) is considered processing if there is subsequent distribution in commerce. Processing implies incorporation; for the purposes of EPCRA Section 313, a constituent Section 313 chemical is "processed" if ore is beneficiated for distribution in

commerce (e.g, sale of a metal concentrate). This is true whether the Section 313 chemical is the target metal or a non-target metal. For example, when copper ore containing traces of lead is beneficiated for distribution in commerce, both lead and copper are processed. In contrast, "otherwise use" implies non-incorporation; the chemical is not intended to become part of a product. For example, the use of sodium cyanide to extract gold from gold ore represents an "otherwise use" of an EPCRA Section 313 chemical.

- **Otherwise Used Activities and Definitions**

  - As a chemical processing aid

    A chemical that is added to a reaction mixture to aid in the manufacture or synthesis of another chemical substance but is not intended to remain in or become part of the product or product mixture. Examples of such Section 313 chemicals include, but are not limited to, process solvents, catalysts, inhibitors, initiators, reaction terminators, and solution buffers.

  - As a manufacturing aid

    A chemical that aids the manufacturing process that does not become part of the resulting product and is not added to the reaction mixture during the manufacture or synthesis of another chemical substance. Examples include, but are not limited to, process lubricants, metalworking fluids, coolants, refrigerants, and hydraulic fluids.

  - Ancillary or other use

    A chemical that is used at a facility for purposes other than aiding chemical processing or manufacturing as described above. Examples of such Section 313 chemicals include, but are not limited to, cleaners, degreasers, lubricants, fuels, and chemicals used for treating wastes.

For purposes of the otherwise use definition, EPA interprets ***waste management*** activities to include recycling, combustion for energy recovery, treatment for destruction, waste stabilization, and release, including disposal. Waste management does not include the storage, container transfer, or tank transfer of a Section 313 chemical if no recycling, combustion for energy, treatment for destruction, waste stabilization, or release of the chemical occurs at the facility. (See 62 FR 23850)

For purposes of the otherwise use definition, EPA interprets ***waste management*** activities to include recycling, combustion for energy recovery, treatment for destruction, waste stabilization, and release, including disposal. Waste management does not include the storage, container

transfer, or tank transfer of a Section 313 chemical if no recycling, combustion for energy, treatment for destruction, waste stabilization, or release of the chemical occurs at the facility. (See 62 FR 23850)

Recycling for the purposes of EPCRA Section 313 means the following: (1) the recovery for reuse of a Section 313 chemical from a gaseous, aerosol, aqueous, liquid, or solid stream; or (2) the reuse or the recovery for use of a Section 313 chemical that is a RCRA hazardous waste as defined in 40 CFR Part 261. Recovery is the act of extracting or removing the toxic chemical from a waste stream and includes: (1) the reclamation of the toxic chemical from a stream that entered a waste treatment or pollution control device or process where destruction of the stream or destruction or removal of certain constituents of the stream occurs (including air pollution control devices or processes, wastewater treatment or control devices or processes, Federal or state permitted treatment or control devices or processes, and other types of treatment or control devices or processes); and (2) the reclamation for reuse of an "otherwise used" toxic chemical that is spent or contaminated and that must be recovered for further use in either the original or any other operations. (See EPA document, *Interpretations of Waste Management Activities: Recycling, Combustion for Energy Recovery, Waste Stabilization and Release.)*

Combustion for energy recovery is interpreted by EPA to include the combustion of a Section 313 chemical that is (1) (a) a RCRA hazardous waste or waste fuel, (b) a constituent of a RCRA hazardous waste or waste fuel, or (c) a spent or contaminated "otherwise used" material; and that (2) has a heating value greater than or equal to 5,000 British thermal units (BTU) per pound in an energy or materials recovery device. Energy or materials recovery devices are boilers and industrial furnaces as defined in 40 CFR §372.3 (See 62 FR 23891). In determining whether an EPCRA Section 313 listed toxic chemical is combusted for energy recovery, the facility should consider the BTU value of the toxic chemical and not of the chemical stream. If the heating value of the Section 313 chemical is below 5,000 BTU, the chemical is being treated for destruction. A facility that blends and subsequently distributes in commerce a waste-derived fuel "processes" EPCRA Section 313 listed toxic chemicals that are constituents of that waste-derived fuel. In contrast, if subsequent to blending the waste-derived fuel, that same facility combusts on-site the waste-derived fuel in an energy recovery unit, the facility "otherwise uses" EPCRA Section 313 listed toxic chemicals that are constituents of that waste-derived fuel. An EPCRA Section 313 listed toxic chemical that has a heat value of less than 5,000 BTUs and that is a constituent of a waste-derived fuel is "otherwise used" if that fuel is combusted in an on-site energy recovery unit (62 FR 23851).

EPA defines ***Treatment for destruction*** to mean the destruction of a Section 313 chemical in waste such that the substance is no longer the toxic chemical subject to reporting under

EPCRA Section 313. Treatment for destruction does not include the destruction of a Section 313 chemical in waste where the Section 313 chemical has a heat value greater than 5,000 British Thermal Units (BTU) and is combusted in any device that is an industrial boiler or furnace. (See 40 CFR §372.3.) "Treatment for destruction" includes acid or alkaline neutralization if the toxic chemical is the entity that reacts with the acid or base. "Treatment for destruction" does not include: (1) neutralization of a waste stream containing toxic chemicals if the toxic chemicals themselves do not react with the acid or base (See 40 CFR §372.3), (2) preparation of a toxic chemical for disposal, (3) removal of toxic chemicals from waste streams, and (4) activities intended to render a waste stream more suitable for further use or processing, such as distillation or sedimentation. For example, neutralization of pure nitric acid is considered treatment for destruction. In contrast, neutralization of nitric acid containing three percent lead is not considered treatment for destruction of the lead component, because the lead has not reacted with the neutralizing agent (See 62 FR 23852).

EPA defines ***Waste stabilization*** to mean any physical or chemical process used to either reduce the mobility of hazardous constituents in a hazardous waste or eliminate free liquid as determined by a RCRA approved test method (e.g., Test Method 9095). A waste stabilization process includes mixing the hazardous waste with binders or other materials and curing the resulting hazardous waste and binder mixture. Other synonymous terms used to refer to this process are "stabilization," "waste fixation," or "waste solidification." (See 40 CFR §372.3.)

Release is defined by EPCRA Section 329(8) to mean any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles) of any toxic chemical. (See 40 CFR §372.3.)

Disposal is defined by EPCRA to mean any underground injection, placement in landfills/surface impoundments, land treatment, or other intentional land disposal. (See 40 CFR §372.3.)

Beneficiation means the preparation of ores to regulate the size (including crushing and grinding) of the product, to remove unwanted constituents, or to improve the quality, purity, or grade of a desired product. (See 40 CFR §372.3.) This definition is broad and includes, all activities mining facilities considered to be beneficiation under the Resource Conservation and Recovery Act (RCRA) definition of beneficiation found at 40 CFR §261.4(b)(7), which states:

> *"...beneficiation of ores and minerals is restricted to the following activities: Crushing; grinding; washing; dissolution; crystallization; filtration; sorting;*

sizing; drying; sintering; pelletizing; briquetting; calcining to remove water and/or carbon dioxide; roasting, autoclaving, and/or chlorination in preparation for leaching (except where the roasting (and/or autoclaving and/or chlorination)/leaching sequence produces a final or intermediate product that does not undergo further beneficiation or processing); gravity concentration; magnetic separation; electrostatic separation; flotation; ion exchange; solvent extraction; electrowinning; precipitation; amalgamation; and heap, dump, vat, tank, and in situ leaching."

Additional activities that occur to prepare ores through regulating the size of the product, removing unwanted constituents, or improving the quality, purity, or grade of a desired product are considered beneficiation for the purposes of EPCRA Section 313 reporting.

EPA believes that "overburden" and "waste rock" constitute two separate and discernable types of waste (62 FR 23859).

Overburden is the unconsolidated material that overlies a deposit of useful materials or ores. It does not include any portion of ore or waste rock. Overburden is specifically exempt from TRI reporting. (See 40 CFR §372.38(h).)

Waste rock as described in the preamble, "generally considered that portion of the ore body that is barren or submarginal rock or ore which has been mined but is not of sufficient value to warrant treatment and is therefore removed ahead of the milling processes. Waste rock is part of the ore body and may, depending on economic conditions, become a valuable source of a metal..." (62 FR 23859)

Based on EPA's evaluation of the metal mining industry, the Agency believes that metal mining activities routinely involve or result in the manufacturing, processing, or otherwise use of EPCRA Section 313 chemicals (62 FR 23834, May 1, 1997). The term manufacture includes the coincidental manufacture of a chemical, such as a byproduct or impurity, from the manufacturing, processing, otherwise use or waste management of another chemical substance or mixture. Thresholds must be calculated separately for manufacture, process, or otherwise use of the same chemical. If any single threshold is exceeded for a listed Section 313 chemical, the facility must submit a Form R covering all nonexempt activities. Metal mining facilities will be required to factor into their threshold determinations and reporting calculations the quantities of EPCRA Section 313 chemicals used in support activities such as froth flotation, non-motor vehicle equipment maintenance, and dewatering. Chemicals involved in these support activities are classified under the otherwise use category.

EXEMPTIONS

Section 313 provides for exemptions from reporting for specific "processing" or "otherwise use" activities. The instructions provided in *Toxic Chemical Release Inventory Reporting Form R and Instructions* should be reviewed carefully before proceeding. The following discussion summarizes the exemption instructions. A facility does not have to consider amounts of listed Section 313 chemicals involved in any of these processing or otherwise use activities when determining if activity thresholds have been exceeded or when estimating environmental releases. Limited exemptions apply to manufacturing activities. For example, manufacturing a Section 313 chemical for research and development purposes and manufacturing as an impurity below a specified level in a product distributed beyond the facility both can be exempt. The EPA's *Toxic Chemical Release Inventory Questions and Answers, Revised 1990 Version* [EPA 560/4/91-003 (will be revised in near future)] and the *Toxic Release Inventory Reporting Form R and Instructions* also contain information about these exemptions. (See Appendix B for ordering information.)

- The ***de minimis*** exemption allows facilities to disregard certain minimal concentrations of chemicals in mixtures or trade name products they "process" or "otherwise use" in making threshold determinations and release and other waste management determinations. Any Section 313 chemical in ore or waste rock that is at a level below *de minimis* concentration and remains below the *de minimis* concentration throughout the extraction process does not have to be factored into threshold or release determinations for amounts processed by the facility. The *de minimis* exemption does not apply to the "manufacture" of a Section 313 chemical except if that Section 313 chemical is "manufactured" as an impurity and remains in the product distributed in commerce below the appropriate *de minimis* level. The *de minimis* exemption does not apply to a byproduct "manufactured" coincidentally as a result of "manufacturing," "processing," "otherwise use," or any waste management activities.

  This *de minimis* exemption applies solely to "mixtures" and trade name products. EPA's long-standing interpretation has been that "mixture" does not include waste. Therefore, the *de minimis* exemption cannot be applied to Section 313 chemicals in a waste even if the waste is being "processed" or "otherwise used."

  When determining whether the *de minimis* exemption applies to a Section 313 chemical, the owner or operator should only consider the concentration of the Section 313 chemical in mixtures and trade name products in process streams in which the Section 313 chemical is undergoing a reportable activity. If the Section 313 chemical in a process stream is "manufactured" as an impurity, "processed," or "otherwise used" and is below the

appropriate *de minimis* concentration level, then the quantity of the Section 313 chemical in that process stream does not have to be applied to threshold determinations nor included in release or other waste management determinations. If a Section 313 chemical in a process stream meets the *de minimis* exemption, all releases and other waste management activities associated with the Section 313 chemical in that stream are exempt from EPCRA section 313 reporting. It is possible to meet an activity (e.g., processing) threshold for a Section 313 chemical on a facility-wide basis, but not be required to calculate releases or other waste management quantities associated with a particular process because that process involves only mixtures or trade name products containing the Section 313 chemical below the *de minimis* level.

Once a Section 313 chemical concentration is above the appropriate *de minimis* concentration, threshold determinations and release and other waste management determinations must be made, even if the chemical later falls below *de minimis* level in the same process stream. Thus, all releases and other quantities managed as waste which occur after the *de minimis* level has been exceeded are then subject to reporting. If a Section 313 chemical in a mixture or trade name product above *de minimis* is brought on-site, the *de minimis* exemption never applies.

The *de minimis* concentration level is consistent with the OSHA Hazard Communication Standard requirements for development of Material Safety Data Sheets (MSDSs). The *de minimis* level is 1.0 percent except if the Section 313 chemical is an OSHA-defined carcinogen. The *de minimis* level for OSHA-defined carcinogens is 0.1 percent. For mixtures or other trade name products that contain one or more members of a listed Section 313 Section 313 chemical category, the *de minimis* level applies to the aggregate concentration of all such members and not to each individually. The list of Section 313 chemicals in the publication *Toxic Chemical Release Inventory Reporting Form R and Instructions* for the current reporting year contains the *de minimis* values for each of the Section 313 chemicals and chemical categories.

- **Materials that are processed or used as articles** - Quantities of a listed Section 313 chemical contained in an article do not have to be factored into threshold or release determinations when that article is processed or otherwise used at your facility. An article is defined as a manufactured item that is formed to a specific shape or design during manufacture, that has end-use functions dependent in whole or in part upon its shape or design during end-use, and that does not release a Section 313 chemical under the normal conditions of the processing or use of that item at the facility.

If the processing or otherwise use of like articles results in a total release of less than 0.5 pounds of a Section 313 chemical in a calendar year to all environmental media, EPA will allow this release quantity to be rounded to zero, and the manufactured items remain exempt as articles. EPA requires facilities to round off and report all estimates to the nearest whole number. The 0.5-pound limit does not apply to each individual article, but applies to the sum of all releases from processing or otherwise use of like articles.

The article exemption applies to the normal processing or otherwise use of an article. It does not apply to the manufacture of an article. Thus, Section 313 chemicals processed into articles manufactured at a facility must be factored into threshold and release determinations.

A closed item containing Section 313 chemicals (e.g., a transformer containing PCBs) that does not release the Section 313 chemicals during normal use is considered an article if a facility uses the item as intended and the Section 313 chemicals are not released. If a facility services the closed item (e.g., a transformer) by replacing the Section 313 chemicals, the Section 313 chemicals added during the reporting year must counted in threshold determinations.

- **Materials that are structural components of the facility** - Chemicals present in materials used to construct, repair, or maintain a plant building are exempt from the activity thresholds. For example, solvents and pigments present in paint used to coat the structural components of a building would be exempt from threshold determination and release reporting.

- **Materials used for janitorial or facility grounds maintenance** - Chemicals present in materials used for routine or facility grounds maintenance are exempt from the activity thresholds. Examples include bathroom cleaners, fertilizers, and garden pesticides in the same form and concentration commonly distributed to consumers. Chemicals used for equipment maintenance, such as the use of oil or cleaning solvents, are not exempt.

- **Materials used with facility motor vehicles** - Chemicals present in materials used for operating and maintaining motor vehicles operated by the facility are exempt from the activity thresholds. Examples include gasoline, radiator coolant, and windshield wiper fluid used in equipment such as cars, trucks, forklifts, and tow motors.

- **Personal items** - Chemicals present in materials such as foods, drugs, cosmetics, or other personal items are exempt from the activity thresholds. Examples include materials used in the facility cafeteria and infirmary. Chemicals used for heating and air conditioning solely to provide comfort to personnel are also exempt from reporting. If a building's temperature is

regulated to facilitate a process or treatment operation, the Section 313 chemicals used to heat or cool the building are not exempt. Units that supply both personal comfort and operational needs may be apportioned, if it is possible to separate them.

- **Laboratory materials** - Chemicals used in certain laboratory activities that are conducted under the supervision of a technically qualified individual (as defined under 40 CFR §720.3(ee)) are exempt from the activity thresholds. The laboratory activities exemption applies only to sampling and analysis, research and development, and quality assurance and quality control activities. The exemption does not apply to the use or production of listed Section 313 chemicals in pilot-plant operations and laboratories for distribution in commerce (e.g., specialty chemicals) and laboratory support services.

- **Materials as they are drawn from the environment or municipal sources** - Chemicals contained in intake water (used for processing or non-contact cooling) or in intake air (used either as compressed air or for combustion) are exempt from the activity thresholds.

- **Property owners** - Property owners that merely own real estate on which a facility covered by Section 313 is located and have no business interest in the operation of that facility (e.g., a company owns an industrial park) are exempt for Section 313 reporting. The operator of that facility, however, is subject to reporting requirements.

SUPPLIER NOTIFICATION REQUIREMENTS

Because manufacturers reporting under Section 313 must know the Section 313 chemical composition of the products they use to be able to accurately calculate releases, EPA requires some suppliers of mixtures or trade name products containing one or more of the listed Section 313 chemicals to notify their customers of the identity of the chemical in the mixture or the trade name product. This requirement has been in effect since January 1, 1989.

A facility must comply with the Section 313 supplier notification requirements if it owns or operates a facility which meets all of the following criteria.

- The facility is in SIC codes 20-39,

- The facility manufactures, imports, or processes a Section 313 chemical, and

- The facility sells or otherwise distributes in commerce a mixture or trade name product containing the Section 313 chemical to either:

  - A facility described in 40 CFR §372.22 (covered facility group), or
  - A facility that then sells the same mixture or trade name product to a facility described in 40 CFR §372.22 (covered facility group).

The supplier notification requirements do not apply to TRI chemicals that are themselves wastestreams or are constituents of wastestreams.

LISTED SECTION 313 CHEMICALS

Appendix A to this document contains an alphabetical listing of the chemicals subject to Section 313 reporting at the time of publication of this document, including their *de minimis* concentrations. EPA publications *Common Synonyms for Section 313 Chemicals* (EPA 745-R-95-008) and *Consolidated List of Chemicals Subject to Reporting Under the Act (Title III List of Lists)* (EPA-550-B-96-015) may also be useful references when reviewing the chemicals at your facility for Section 313 coverage.

The list of Section 313 chemicals is amended frequently. Users of this guidance document or other documents listing Section 313 chemicals are cautioned that changes may have occurred to the list of Section 313 chemicals since publication of the original list or addition of the chemical through administrative action. The list of Section 313 chemicals presented in the *Toxic Chemical Release Inventory Reporting Form R and Instructions* for the current reporting year should always be consulted as the most up-to-date source of currently listed Section 313 chemicals. For the latest information on Section 313 chemical listings, contact the EPCRA Hotline at 1-800-535-0202.

Some of the Section 313 chemicals have qualifiers included with their names. Reporting on these chemicals are determined by the conditions specified in the qualifiers. Chemicals that are listed without parenthetic qualifiers are subject to reporting in all forms in which they are manufactured, processed, or otherwise used. Descriptions of the qualifiers are as follows:

- **Fume or dust** - Three of the metals on the list of Section 313 chemicals (aluminum, vanadium, and zinc) contain the qualifier "fume or dust." Fume or dust refers to dry forms of these metals, not to "wet" forms such as solutions or slurries. Thus, a facility should determine if, for example, it generated more than 25,000 pounds of "aluminum (fume or dust)." Similarly, there may be certain technologies in which one of these metals is processed in the form of a fume or dust to make other Section 313 chemicals or other products for distribution in commerce. In reporting releases, the facility would report only releases of the fume or dusts.

  EPA considers dusts to consist of solid particles generated by any mechanical processing of materials including crushing, grinding, rapid impact, handling, detonation, and decrepitation of organic and inorganic materials such as rock, ore, and metal. Dusts do not tend to flocculate, except under electrostatic forces. A fume is an airborne dispersion consisting of small solid particles created by condensation from a gaseous state, in distinction to a gas or vapor. Fumes arise from the heating of solids such as aluminum. The condensation is often accompanied by a chemical reaction such as oxidation. Fumes flocculate and sometimes

coalesce. Other metals, (e.g., such as lead or copper) are not limited by this qualifier and are subject to reporting in all forms (fume, dust, and wet).

- **Manufacturing qualifiers** -Two of the entries in the Section 313 chemical list contain a qualifier relating to manufacture. For isopropyl alcohol, the qualifier is "manufacturing - strong acid process". For saccharin the qualifier simply is "manufacturing." For isopropyl alcohol, the qualifier means that only facilities manufacturing isopropyl alcohol by the strong acid process are required to report. In the case of saccharin, only manufacturers of the Section 313 chemical are subject to the reporting requirements. A facility that processes or otherwise uses either Section 313 chemical would not be required to report for those chemicals. In both cases, the facility is not required to provide supplier notification because only the manufacturer, not the user, of the Section 313 chemical must report.

- **Ammonia (includes anhydrous ammonia and aqueous ammonia from water dissociable ammonium salts and other sources; 10 percent of total aqueous ammonia is reportable under this listing)** - The qualifier for ammonia means that anhydrous forms of ammonia are 100 percent reportable and aqueous forms are limited to 10 percent of total aqueous ammonia. Therefore, when determining thresholds, releases, and other waste management quantities all anhydrous ammonia is included but only 10 percent of total aqueous ammonia is included. Any evaporation of ammonia from aqueous ammonia solutions is considered anhydrous ammonia and should be included in the appropriate threshold and release determinations.

- **Phosphorus (yellow or white)** - The listing for phosphorus is qualified by the term "yellow or white" This means that only manufacturing, processing, or otherwise use of phosphorus in the yellow or white chemical forms require reporting. Conversely, manufacturing, processing, or otherwise use of "black" or "red" phosphorus does not trigger reporting.

- **Asbestos (friable)** - The listing for asbestos is qualified by the term "friable," referring to the physical characteristic of being able to be crumbled, pulverized, or reducible to a powder with hand pressure. Only manufacturing, processing, or otherwise use of asbestos in the friable form triggers reporting.

- **Aluminum oxide (fibrous forms)** - The listing for aluminum oxide is qualified by the term "fibrous forms." Fibrous refers to a man-made form of aluminum oxide that is processed to produce strands or filaments which can be cut to various lengths depending on the application. Only manufacturing, processing, or otherwise use of aluminum oxide in the fibrous form triggers reporting.

- **Hydrochloric acid and sulfuric acid (acid aerosols including mists, vapors, gas, fog, and other airborne forms of any particle size)** - The qualifier for hydrochloric acid and sulfuric acid means that only aerosol forms of this chemical are reportable. Aqueous solutions are not covered by this listing, but airborne forms generated from aqueous solutions are covered.

- **Nitrate compounds (water dissociable; reportable only when in an aqueous solution)** - The qualifier for the nitrate compounds category limits the reporting to nitrate compounds that dissociate in water, and thereby generate nitrate ions. For the purposes of threshold determinations, the entire weight of the nitrate compound must be included in all calculations. For the purposes of reporting releases and other waste management quantities, only the weight of the nitrate ion should be included in the calculations of these quantities.

WHAT MUST BE REPORTED?

If your facility is included in the specified set of SIC codes, has ten or more full-time employees or the equivalent, and manufactures, processes, or otherwise uses one of the listed Section 313 chemicals in amounts greater than the appropriate thresholds, you must report the following information on Form R:

- Name and location of your facility;

- Identity of the listed Section 313 chemical (unless you claim its identity to be a trade secret);

- Whether you manufacture, process, or otherwise use the chemical any other way;

- Maximum quantity of the chemical on-site at any time during the year;

- Quantities of the chemical released during the year to environmental media, including both accidental spills and routine emissions;

- Quantities of the chemical subject to on site waste management actions, including recycling, energy recovery, or waste treatment;

- Off-site locations to which you shipped wastes containing the chemical and the quantities of the chemical sent to those locations;

- Information on source reduction activities; and

- Treatment methods used for wastes containing the chemical and estimates of their efficiency for the reportable Section 313 chemical.

A release is defined under EPCRA Section 329(8) as any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of any listed Section 313 chemical. The definition of release includes the abandonment or discarding of barrels, containers, and other closed receptacles. Separate release estimates must be provided for releases to air, water, and land (e.g., deep well injection, surface impoundment, permitted landfill).

DOCUMENTING REPORTING EFFORTS

Sound recordkeeping practices are essential for accurate and efficient TRI reporting. EPA requires that facilities keep a copy of each Form R or Form A report filed for at least three years from the date of submission (40 CFR §372.10). These reports will also be of use to facilities in subsequent years when completing future Form R or Form A reports. EPA also requires that facilities maintain those documents, calculations, worksheets, and other forms upon which they relied to file Form R or Form A reports. EPA may request this supporting documentation from the facility, for example, to conduct data quality reviews of present or past Form R or Form A submissions.

Supporting documentation, organized by year, that a facility should maintain may include, if applicable:

- Previous years' Forms Rs and Form As;
- Section 313 Reporting Threshold Worksheets (a sample worksheet is given in the *Toxic Chemical Release Inventory Reporting Form R and Instructions* document;
- Engineering calculations and other notes;
- Purchase records from suppliers;
- Inventory data;
- EPA (NPDES) permits and monitoring reports;
- EPCRA Section 312, Tier II Reports;
- Monitoring records;

- Flowmeter data;
- RCRA Hazardous Waste Generator's Report;
- Pretreatment reports filed by the facility with the local government;
- Invoices from waste management companies;
- Manufacturer's estimates of treatment efficiencies;
- RCRA Manifests; and
- Process diagrams.

SECTION 3
MAKING THE THRESHOLD DETERMINATION

A separate Toxic Chemical Release Inventory Reporting Form must be submitted for each listed chemical that is "manufactured," "processed," or "otherwise used" above an activity threshold at your facility, assuming the SIC code and employee criteria are met. Current EPCRA Section 313 guidance for metal mining facilities is shown in Table 3-1:

Table 3-1. Examples of Manufactured, Processed, and Otherwise Used Chemicals at Metal Mines *

Manufactured Chemicals	
Byproducts or coincidentally manufactured Section 313 chemicals are not subject to the *de minimis* exemption and all quantities of such chemicals should be included in your threshold determination for **manufacturing** of the new Section 313 chemical. This includes Section 313 chemicals manufactured in tailings impoundments.	
If an elemental metal is converted to a metal compound, or if one metal compound is converted to another metal compound, then a metal compound has been **manufactured,** even if it is within the same Section 313 metal compound category. The quantity of the Section 313 metal compound manufactured must be counted towards the 25,000 pound threshold.	
Activity	**Examples**
Produced or imported for on-site use/processing	Conversion of copper sulfide to copper sulfate in the leaching process.
Produced or imported for sale/distribution	Conversion of copper sulfate to copper (cathodes) in electrowinning.
Produced as a by-product	Sulfuric acid aerosols formed by spraying sulfuric acid solutions in the leaching process.
Produced as an impurity	Conversion of trace amounts of compounds of lead, copper, nickel, or mercury to elemental forms in gold dore shipped offsite as product.

Processed Chemicals	
The recovery of a Section 313 chemical from a mixture for further distribution is **processing** of that chemical. Metal recovery from metal bearing ores that result in a product that is sold should be considered in your threshold determination for processing activities. Similarly, Section 313 metals in tailings distributed in commerce for reclamation must be counted towards the **processing** threshold.	
Activity	**Examples**
As a reactant	Zinc dust that is used to precipitate gold from pregnant gold-cyanide solutions. Flotation reagents such as benzene, arsenic compounds, chromium compounds, and copper compounds, used in mineral beneficiation that remain in the product.
As a formulation component	May not occur in metal mining.
As an article component	Copper cathodes produced from electrowinning
Repackaging only	May not occur at a mining facility.
Otherwise Used Chemicals	
The use of a Section 313 chemical in a mixture that is not incorporated into products distributed by the facility is **otherwise use** of that chemical. Cyanide compounds used in leaching processes to concentrate Section 313 metals (or metal compounds) from ore materials extracted from the ground are "otherwise used" because the cyanide compounds are not distributed in commerce. These compounds should be considered in your threshold determination as otherwise use activities.	
Activity	**Examples**
As a chemical processing aid	Lead-based steel wool used as a cathode in the electrowinning process. Chemicals used in solvent extraction/electrowinning. Cyanide leaching for beneficiation of gold ores.
As a manufacturing aid	Nitric acid used to regenerate carbon adsorption beds used in cyanide leaching process. Sulfuric acid used to regenerate carbon filters, only to the extent that sulfuric acid fumes are released.
Ancillary or other use	Naphthalene in diesel fuel used in stationary equipment. Chlorine used to treat cyanide in waste water.

*More complete discussions of the industry-specific examples can be found in Section 5 of this guidance manual.

- For threshold determinations, the concentration of metal compounds is determined by the total weight percent of the compound, not the parent metal.

- If more than one Section 313 metal compound within a Section 313 metal compound category is present in the ore, the concentration is determined by the total weight percent of all compounds within a specific listed Section 313 category. That concentration would be used to determine the applicability of the *de minimis* exemption and to calculate threshold determinations, if appropriate. Facilities should factor in variability of the metal compounds within the ore. Variability in an ore body is expected. In calculating the activity threshold, the facility should develop an average based on known information. If sampling normally conducted by the facility produces results of varying concentrations, these should be averaged for an overall average concentration. If the facility has more than one extraction point, and sampling yields consistent results per point of extraction but different results as compared to other points of extraction (e.g., one area above *de minimis* and one below), then the facility may develop an activity threshold estimate separately for each area sampled for purposes of determining reporting thresholds.

- The Section 313 chemicals present in "overburden," the unconsolidated material that overlies a deposit of useful materials or ores, is exempt from threshold determinations and release calculations if processed or otherwise used by metal mining facilities within SIC code 10.

- Waste rock is not considered overburden because it is considered a portion of the ore body and may, depending on economic conditions, become a valuable source of a metal or metal compound. Waste rock that is separated from the ore body and deposited on-site or transferred off-site for purposes of disposal or other waste management activities has not undergone an EPCRA Section 313 reportable activity, and therefore, amounts of Section 313 chemicals contained in the waste rock do not have to be considered towards activity thresholds.

CONDUCTING THE THRESHOLD DETERMINATION

STEP ONE
Identify Section 313 chemicals that are manufactured, processed or otherwise used.

An activity threshold determination must be made individually for each Section 313 chemical by each activity in which the chemical is manufactured, processed, or otherwise used at your facility. The threshold determination is one criterion used to ascertain whether a Form R or Form A is required to be submitted.

The primary function of most mining facilities is the extraction and beneficiation of metal ore to produce a metal concentrate. The purpose of beneficiation is to concentrate the valuable metal in the ore by separating the valuable portion from the non-valuable portion. The beneficiation method or methods used vary with mining operations and depend on ore characteristics and economic considerations and include flotation, leaching, solvent extraction, electrowinning and other methods. To perform a comprehensive and accurate threshold determination, the facility must determine (1) what Section 313 chemicals (such as metals and metal compounds) are present in the mined ore and at what concentrations, (2) what Section 313 chemicals (such as metals and metal compounds) that are present in the mined ore below *de minimis* concentrations are concentrated above *de minimis* at some point in the beneficiation process, and (3) what chemicals (flotation agents, leaching agents, cyanides, equipment maintenance chemicals, waste treatment chemicals, etc.) are otherwise used during the beneficiation activities.

Sulfuric Acid Aerosols

Sulfuric acid is only a Section 313 chemical when it exists as an acid aerosol including mists, vapors, fog, and other airborne species of any particle size. Producing a sulfuric acid aerosol from liquid sulfuric acid is considered "manufacturing" under TRI. In some leaching operations, dilute sulfuric acid is sprayed or dripped onto the ore. This spraying or dripping may result in the manufacture of sulfuric acid in the aerosol form. Facilities should apply the total volume of acid in the spraying system during the reporting year to the threshold, rather than count all quantities of acid aerosol generated in the system. Since the acid aerosols are "manufactured" and then **"otherwise used"** in these acid reuse systems, the 10,000 pound "otherwise use" threshold would be the threshold that would first trigger reporting from such systems. For example, if a facility starts the year with 2,000 pounds of sulfuric acid in the system, and adds 500 pounds during the reporting year, 2,500 pounds of sulfuric acid aerosol would be applied to the manufacturing and otherwise use threshold.

Some processing activities will involve the conversion or reaction of chemicals to produce a new chemical, such as occurs with chemical oxidation or chemical precipitation. Mining facilities should closely examine their processes to determine whether a Section 313 chemical are manufactured. (See box.)

Carefully examine the Section 313 list of chemicals in Appendix A and check the list of Section 313 chemicals in the publication *Toxic Chemical Release Inventory Reporting Form R and Instructions* for the current reporting year to determine whether the list of chemicals has been updated.

Any chemical purchased by facilities for use as processing or manufacturing aids or for treating waste are considered "otherwise used". In addition, EPCRA Section 313 chemicals in materials purchased to be used as fuel or for maintaining equipment operations, other than for maintaining motor vehicles,

should be included in the threshold determination for "otherwise use" activities. Any EPCRA Section 313 chemicals in materials purchased to be used in the waste management processes should also be included in the threshold determination for "otherwise use" activities.

When performing your threshold determinations, it is important to remember that exemptions apply to certain facility-related activities. These exemptions were discussed in Section 2 of this guidance document and may apply only to certain "manufacturing," "processing," or "otherwise use" activities. For the purposes of an activity threshold analysis, the following areas should be examined closely to determine whether the TRI chemicals subject to certain activities should be included in the activity threshold and reporting calculations:

STEP TWO

Identify "processing" and "otherwise use" activities that are subject to exemptions. Exclude chemicals associated with these activities from your threshold determination.

- **Overburden**: The Section 313 chemicals present in "overburden," the unconsolidated material that overlies a deposit of useful materials or ores, are exempt from threshold determinations and release calculations if processed or otherwise used by metal mining facilities within SIC code 10.

- **Laboratories**: Sampling and analysis, research and development (R&D), and QA/QC activities undertaken in laboratories are exempt if conducted under the supervision of a technically qualified individual. Pilot plants and support services, such as photo processing, waste water treatment, and instrument sterilization are not exempt. Wastes generated during sampling and analysis, R&D, and QA/QC activities in an on-site laboratory are exempt.

- **Motor vehicles**: Use of products containing Section 313 chemicals used for maintaining motor vehicles operated by the facility are exempt, as well as the fuels used in those vehicles.

- **Routine janitorial or facility grounds maintenance**: The routine maintenance exemption is intended to cover janitorial or other custodial or plant grounds maintenance activities using such substances as bathroom cleaners, or fertilizers and pesticides used to maintain lawns, in the same form and concentration commonly distributed to consumers. Equipment maintenance such as the use of oil or grease is not exempt.

- **Materials as they are drawn from the environment or municipal sources-** Chemicals contained in intake water (used for processing or non-contact cooling) or in intake air (used either as compressed air or for combustion) are exempt from the activity thresholds. However, EPCRA Section 313 chemicals manufactured from use of the air or water are not exempt and must be considered for the threshold determination.

In making threshold determinations, it is important that you keep in mind that a *de minimis* exemption applies only to Section 313 chemicals in mixtures or trade name products manufactured as impurities or processed or otherwise used in mixtures or trade name products. This exemption does not apply to chemicals that are manufactured as byproducts nor does it apply to chemicals in wastes that are processed or otherwise used.

STEP THREE

Determine whether TRI chemicals are present in mixtures or trade name products that are processed or otherwise used below the *de minimis* concentration threshold and eliminate from further consideration in your processing and otherwise use threshold determination those chemicals below *de minimis*, unless those chemicals are later concentrated. Also determine whether chemicals are present as impurities below the *de minimis* concentration threshold in manufactured products and eliminate from further consideration in your manufacturing threshold determination those chemicals below *de minimis*.

Metal mining facilities should bear in mind that metal beneficiation processes concentrate metals and/or metal compounds. In instances where the ore as mined did not contain Section 313 chemicals above the *de minimis* concentration, concentrating the metal and/or the metal compounds could result in the metal and/or the metal compound being present above the *de minimis* concentration. From the point at which the metal and/or the metal compound meets or surpasses the *de minimis* concentration, the metal should be included in your threshold determination and release estimates. For example, metals may become concentrated in a tailings pond.

Section 313 chemicals present at less than 1 percent (<10,000 ppm) for chemicals that do not meet the OSHA carcinogen standard or less than 0.1 percent (<1,000 ppm) for chemicals that do meet the OSHA carcinogen standard do not have to be considered when making your threshold determinations for processing or otherwise use. Appendix A to this document contains the list of Section 313 chemicals subject to reporting, along with the *de minimis* concentration associated with the chemical. The list of Section 313 chemicals in the publication *Toxic Chemical Release Inventory Reporting Form R and Instructions* for the current reporting year should also be checked to determine whether the list of chemicals has been updated (e.g., changes in listed chemicals and chemical categories, and *de minimis* levels).

Threshold determinations are made based on the best available information in your possession. Inventory data, consumption information, and supplier notifications can be used in determining the amount of chemicals used for the purpose of making a threshold determination. In general, the type of data to be used in calculating threshold determinations is shown below:

STEP FOUR

Gather data needed for calculations of threshold determination, including:

- **Inventory Data**
- **Consumption Information**
- **Supplier Notification**
- **Ore Sampling and Analysis Data**
- **MSDS**
- **Analysis of Waste Products**
- **Permits**

- Analysis prior to extraction,
- Analysis during/after beneficiation,
- Analysis during/after leaching,
- Volume determination, or
- Estimations.

Where data are lacking and the metal mining facility has reason to suspect that a TRI chemical is present, reasonable estimates should be made. For example, a typical concentration may be established based on best engineering judgement. Where the metal mining facility does not have a reason to suspect that such a Section 313 chemical is present in a mixture, that mixture need not be included in the threshold determination.

Further, tailings impoundments found at mining operations perform a number of functions, including the following:

- Removal of suspended solids by sedimentation
- Precipitation of heavy metals as hydroxides
- Permanent containment of settled tailings
- Stabilization of some oxidizable constituents (e.g., thiosalts, cyanides, flotation reagents)
- Storage and stabilization of process recycle water

Sources of Information for Metal Compound Threshold Determinations

Metal mining facilities should use the best available information for determining thresholds of metal compounds in ore. In the absence of recent data (such as current ore analysis), historical data such as those collected before or during the mine's first operations may provide reasonable estimates. Metal mining facilities that only know total elemental metal concentrations in ore, (i.e., do not know the specific compounds present in the ore), can use additional information to make a reasonable threshold determination. For example, if the facility has information indicating that the metal will naturally exist as a particular type of compound (e.g., copper sulfides) the facility can assume the metal exists as the lowest weight sulfide compound (e.g., CuS). If the facility has no information on the type of compound that is present (e.g., does not know if a non-target metal exists as a sulfide, oxide, carbonate, etc.), they may assume that the metal exists as the lowest weight oxide.

Some or all of these functions can result in the manufacture of Section 313 chemicals that are subject to reporting, such as the manufacture of a metal hydroxide that is a Section 313 chemical. Other chemicals may be added to the tailings impoundment to promote precipitation, stabilization, or oxidation. If these are Section 313 chemicals, they are "otherwise used" and should be considered in making threshold determinations, as discussed in this section, as well as release estimates, as discussed in Section 5.

Threshold determinations are made based on the best available information in your possession. In general, the following methods should be employed to determine the appropriate concentrations to use in threshold determinations:

- If the exact concentration is known (e.g., 33.0% toluene), use it.
- If only the upper bound is known (e.g., <5% toluene), use it (e.g., 5% toluene).
- If the concentration is know (e.g., 10-30% toluene), then use the midpoint (e.g., 20% toluene).
- If only the lower bound is known, assume the upper bound is 100%. Factor out other known constituents (e.g., 10% water

STEP FIVE

Calculate the quantity of each chemical manufactured, processed and otherwise used, in pounds, to determine whether the activity threshold has been exceeded. The Form R must be completed for each chemical otherwise used in excess of 10,000 pounds and for each chemical processed in excess of 25,000 pounds, for each chemical manufactured in excess of 25,000 pounds.

and >60%toluene), create a range (e.g., 60-90% toluene) and then use the midpoint (e.g., 75% toluene).

In cases where certain materials that have broad ranges or high upper bounds for multiple constituents (e.g., %x+%y+%z=110% of mixture), the total components of a mixture should not exceed 100%. In these instances, the best available information should be used to estimate the approximate concentration of the chemicals in the material. However, if a facility is aware that a chemical is probably present in a mixture but has no information on its concentration in the mixture, then they are not required to consider that chemical in its threshold determinations.

THRESHOLD DETERMINATIONS FOR ELEMENTS AND COMPOUNDS

Many metals are Section 313 chemicals, and a mine that processes quantities of Section 313 metals in excess of the 25,000-pound per year threshold must complete a Form R for the metal and estimate releases if the concentrations of these metal ever meet or exceed the *de minimis* concentration during the beneficiation process. (See Appendix A for list of chemicals and *de minimis* concentrations) **The metal in the ore can exist in its elemental form but more commonly exists in the compound state.** Antimony compounds, arsenic compounds, barium compounds*, cadmium compounds, chromium compounds, cobalt compounds, copper compounds*, lead compounds, manganese compounds, mercury compounds, nickel compounds, selenium compounds, silver compounds, thallium compounds, and zinc compounds are separate Section 313 chemical categories distinct from the elemental form.

Therefore, **two separate and exclusive threshold determinations must be made -- one for the elemental metal and one for total metal compounds.** Threshold determinations for the metal compound categories require the calculation to be made on the cumulative weight of all metal compounds in that category that are in a mined ore. If the mined ore contains metal compounds at or above the *de minimis* concentration by weight on a compound basis or if the mined ore is beneficiated and the metal compounds are concentrated such that the total concentration of metal compounds is at or above the *de minimis* concentration, then releases of the parent metal only need to be estimated and reported from the point in the process in which the metal compounds first meet or exceed the *de minimis* level. For mined ores containing more than one member of a listed Section 313 metal compound category, the *de minimis* level applies to the aggregate concentration of all members within the listed category, and not to each individually.

Ore also may contain other metals or metal compound categories than the valued minerals. If the concentration of these other metals or metal compounds exceed the *de minimis* concentration, then releases of these metals also need to be reported.

Compounds that contain metals from one or more different metal compound categories are counted towards the threshold for each category. For example, the entire weight of Cu_3AsS_4 (enargite) would be considered towards thresholds for both copper compounds and arsenic compounds.

*See Appendix A for exceptions to the copper compounds and barium compounds categories.

SECTION 4
OVERVIEW OF SECTION 313 RELEASE ESTIMATION

This section presents general guidelines for preparing Section 313 release estimates. It begins with a discussion of general ideas on estimating chemical releases. A summary of errors that commonly occur in Section 313 reporting follows.

GENERAL CONCEPTS

Release Estimation

A Form R or Form A must be completed for each Section 313 chemical that meets the applicable activity thresholds. Each form requests facility specific information and identifies the chemical for which thresholds were exceeded. Form A (the abbreviated report) includes a statement that the facility did not exceed specified amounts while, the main components of Form R are environmental release estimates to all media for the reportable chemical during the preceding calendar year. This includes all wastes containing the reportable Section 313 chemical that are sent off-site from the facility for further waste management. Specifically, facility release estimates must be made for the following release sources:

- Releases to air from fugitive or non-point sources (Section 5.1)
- Releases to air from stack or point sources (Section 5.2)
- Releases to water directly discharged to a receiving stream (Section 5.3)
- Releases in wastes that are injected underground (Section 5.4)
- Releases to land on-site (Section 5.5)
- Releases to water discharged to a publicly owned treatment works (POTW) (Section 6.1)
- Wastes transferred off-site for recycling, energy recovery, waste treatment, or disposal (Section 6.2)

Waste Rock

As discussed in Section 3 of this document, waste rock that is separated from the ore body and deposited on-site or transferred off-site for purposes of disposal or other waste management activities has not undergone an EPCRA Section 313 reportable activity, and therefore, amounts of Section 313 chemicals contained in the waste rock do not have to be considered towards activity thresholds.

However, because the waste rock has not undergone a reportable activity does not infer that waste management activities associated with the waste rock are exempt. In the above description (where the waste rock is simply disposed of), amounts of the EPCRA Section 313 chemicals in the waste rock must be considered for release and other waste management reporting (e.g. , disposed to land on-site), provided that an activity threshold has been exceeded elsewhere at the facility.

Additionally, because the waste rock has not undergone a "threshold activity", (i.e., "manufacture, process, or otherwise use") amounts of EPCRA Section 313 chemicals further managed as waste are not eligible for the *de minimis* exemption.

Amounts of EPCRA Section 313 chemicals in waste rock must be considered toward the "processing" threshold if the waste rock is distributed in commerce for beneficial reuse (e.g., as roadfill), or if the waste rock undergoes beneficiation (actually no longer

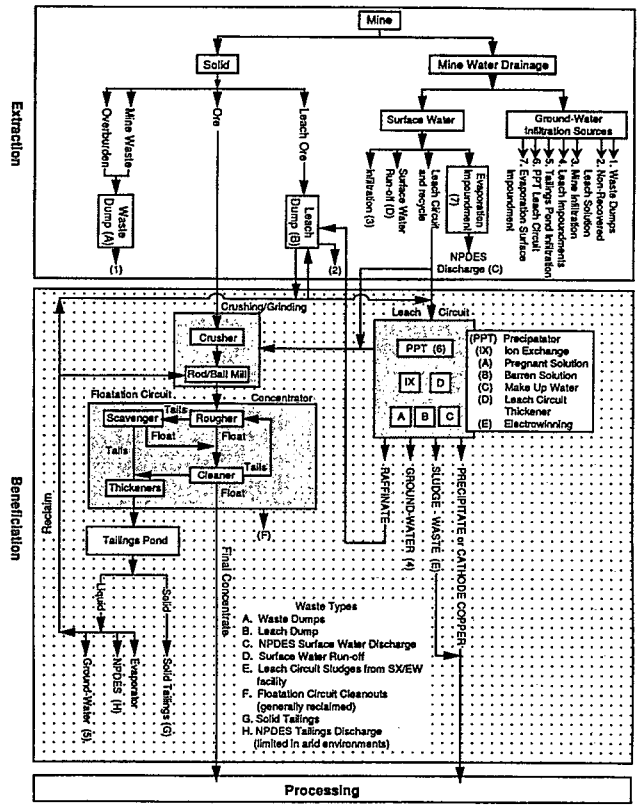
Development of accurate and comprehensive release estimates requires consideration of all possible release pathways. The threshold determination provides valuable information when beginning the release estimation process for a Section 313 chemical: each material containing a Section 313 chemical is identified. For each of these materials, the facility should identify all potential release sources. A useful way to do this is to draw a process flow diagram that traces the material's path through the plant. The process flow diagram should identify each major piece of equipment (including pollution control devices) through which the material passes, from its initial entry into the facility to its final disposition. The diagram should also identify all potential release sources and pollution control equipment for the chemical.

Underground Mines

Waste rock that remains underground is reported as a release to land (Part II, Section 5.5.4 of Form R - Other Disposal). Fugitive emissions underground that are not released to the air but settle underground are also reported as a release to land (Section 5.5.4 of

As a guide to better understanding releases, Figure 4-1 presents the steps typically used in the copper mining industry, beginning with extraction. Releases associated with extraction are reportable, with the exception of releases from overburden, which are exempt under 40 CFR §372.38(h). Overburden is the unconsolidated material that overlies a deposit of useful materials or ores. Figure 4-1 presents the extraction phase at the top, in the white box. Potential release pathways include disposal of leach ore in leach dumps, disposal of waste rock in waste dumps, and releases to surface water.

Figure 4-1. Schematic of Typical Copper Mining Extraction and Beneficiation Wastestreams



In the copper beneficiation process, crushing and grinding, flotation[1], and leaching are used. Figure 4-1 also presents the potential solid waste and water releases from these processes as well as the points where on-site recycling or reclamation can occur. In addition to land and water releases and recycling activities shown, mines will have fugitive air emissions of fume and dust (all particle sizes are included). These air emissions will be higher in dry operations than in wet operations, and should also be considered in Section 313 reporting. Mines can utilize process flow diagrams, such as the one presented in Figure 4-1, to identify potential points of release of Section 313 chemicals. (The boxes which differentiate extraction and beneficiation in Figure 4-1 are for illustrative purposes only. Any official determination of the RCRA status of a mining activity should be obtained from the appropriate State or EPA Region.)

After you have identified all the potential release sources for a chemical, you can estimate releases for each source. Often, the starting point for a release estimate is chemical throughput data, which are typically available from threshold determination calculations.

Given the chemical throughput quantities for a process, you must apply other data and assumptions to complete the estimates. This information includes process-specific data (e.g., scrubber efficiency) and any data developed for other environmentally oriented purposes (e.g., air and wastewater monitoring data, air and water permits and permit applications, RCRA manifest data, monitoring data).

Section 313 does not require any new monitoring to be performed. Facilities should use existing data to calculate release estimates. The accuracy of a release estimate is proportional to the quantity and quality of the data used in its preparation. Situations may arise where estimates based on one set of data contradict estimates based on another. In such cases, the facility should document the rationale for using one data set (or method) versus another. If a facility is aware that a chemical is probably present but has no method to estimate releases or quantities on site, then they are not required to report on that chemical.

Release estimates can be developed by combining all available data with assumptions concerning the fate of each chemical in the process. There are four general methods for developing a release estimate. These methods may be used together or in sequence in developing release estimates.

[1] Flotation is the process where particles of one or more minerals are preferentially wetted by various agents causing the hydrophobic minerals to adhere to the surfaces of air bubbles. As the air bubbles rise to the surface, the desired minerals are transported to the surface and are removed by skimming. See Chapter 5 for more details.

- **Direct measurement** (basis of estimate code = M; entered in Part II Sections 5 and 6) - These are estimates based on actual monitoring of the concentration of a chemical. The chemical's concentration in the waste stream multiplied by the flow rate or volume of the waste stream and its density yields the mass of the chemical released. Direct measurement is typically used to estimate releases via wastewater, solid waste, and hazardous waste, in part, to ensure compliance with applicable environmental regulations. Although this estimation method should yield the most accurate results, only rarely are sufficient data available for direct measurement data to be applied without also resorting to other techniques (e.g., engineering calculations, mass balance). The frequency of the direct measurements should be taken into account when determining if monitoring data alone are sufficient for making a reasonable estimate. For example, if a facility has only gathered monitoring data once throughout the year, other methods may provide a more accurate estimate.

  Note that if a measurement indicates that a Section 313 chemical is below detection, this is not equivalent to stating that the chemical is not present. If the Section 313 chemical is known to be present, a concentration equivalent to half the detection limit should be used in subsequent calculations of release estimate quantities (i.e., if the limit of detection is 10 mg/l, release calculations should be performed during a concentration of 5 mg/l). If the Section 313 chemical is not known to be present in the waste, then zero can be assumed.

- **Mass balance** (basis of estimate code = C entered in Part II, Sections 5 and 6) - These are estimates based on a knowledge of the quantity of a chemical entering and leaving a process. An imaginary boundary is first drawn around the process, and all streams entering or leaving the boundary are identified. Assuming the amount of the chemical in the process input streams is known, a facility could calculate the quantity in waste streams by difference. A facility would need to account for any accumulation or depletion of the chemical within the mass balance boundary. The equation for mass balance is:

  $$Input + Generation = Output + Amount\ Reacted + Accumulation$$

  Using a mass balance to estimate a relatively small release of a chemical with a large throughput can lead to inaccurate, or even negative release estimates. Even a small percentage error in a large throughput could amount to a greater quantity than the release recalculated. When several large values each with their respective errors are used to calculate a small release, propagation of errors occurs which could yield a highly inaccurate value. Other techniques should be considered in these situations.

Mass balance estimates usually require engineering calculations or assumptions to be made (e.g., all usage results in air or water releases). These assumptions should be explicitly stated in the documentation and should be checked for reasonableness.

- **Emission factors** (basis of estimate code = E entered in Part II, Sections 5 and 6) - Release information derived from facilities or processes similar to yours can be used to estimate releases. Emission factors come in two forms. The first expresses releases as a ratio of the amount of chemical released to facility throughput or production (e.g., 0.5 pound of Chemical X released per every pound of Material Y used). The second provides a typical concentration of a chemical in a waste stream (e.g., 0.1 mg/L of Chemical Z in wastewater from scrubbers). These factors, combined with process throughput or waste stream flow data, can be used as a basis for the release estimate. Many emission factors are available in *Compilation of Air Pollutant Emission Factors* (AP-42). AP-42 can be accessed via the Internet at http://www.epa.gov/ttn/chief/ap42etc.html. The basis of estimate code "E" can only be used for published Section 313 chemical-specific emission factors.

  The reliability of emission factors depends on the quality and quantity of data used in their derivation, plus the similarity of the process to which they are applied and the quality of raw materials for the process.

- **Engineering calculations and assumptions** (basis of estimate code = O entered in Part II, Sections 5 and 6) - Estimates that do not fall into any of the above categories are considered engineering calculations. Typically, these estimates are based on standard engineering principles using properties of the chemicals involved, process data, or process knowledge. Example chemical properties include vapor pressure, solubility in water, and density. Example process parameters include temperature, pressure, and material flow rate. Other examples of engineering calculations would be the use of general equipment emissions factors or non-published, facility-developed emissions factors.

Reasonable Estimates: Significant Figures and Use of Range Codes

EPA recommends that two significant figures be used when reporting release and off-site transfer quantities in Part II, Sections 5 and 6 of Form R. Use of two significant figures may prevent errors from being reported on Form R, because a small calculating error may not impact the final reported quantity if the quantity is rounded to two significant figures. If you have reason to believe that your best estimate of a release quantity is particularly imprecise, you could use one

significant figure or one of the range codes in reporting releases in Part II, Sections 5 and 6 of the Form R, if applicable:

Range Code A = 1 to 10 pounds
Range Code B = 11 to 499 pounds
Range Code C = 500 to 999 pounds

"NA" versus "0"

If you have no releases of a Section 313 chemical to a particular medium, report either "NA," not applicable, or "0," as appropriate. Report "NA" only when there is no possibility a release could have occurred to a specific medium or off-site location. If a release to a specific medium or off-site location could have occurred, but either did not occur or the annual aggregate release was less than 0.5 pounds, report zero. However, if you report zero releases, a basis of estimate must be provided. If use of the Section 313 chemical began in the reporting year, enter "NA" as the production ratio or activity index (Part II, Section 8.9 of the Form R).

For example, if nitric acid is involved in the facility's processing activities but the facility neutralizes the wastes to a pH of 6 or above, then the facility reports a "0" release for the Section 313 chemical. If the facility has no underground injection well, "NA" would be written in Part I, Section 4.10 and checked in Part II, Section 5.4.1 and 5.4.2 of Form R. Also, if the facility did not use the Section 313 chemical in the previous year, the facility would have no basis to develop a production ratio or activity index, "NA" would be checked in Part II, Section 8.9 of Form R.

REPORTING RELEASES IN FORM R, PART II

The following sections discuss the types of release reporting required on the Form R. Releases must be partitioned into land and air releases and should not be inadvertently "double counted." For example, a single wastewater discharge should not be listed as both a release to water (on-site) and a discharge to a POTW (off-site), nor should a release to land be listed as a release to both land (on-site) and a transfer to an off-site landfill. Also, subsequent releases from land (such as a leak from an impoundment) to groundwater is included as a land release in the year the leakage occurred. No reporting is required past the year in which it occurred,even if it leaches out to ground water in the next year.

It is important to note that historical releases are not included in release reporting. For example, contamination around an underground storage tank (UST) is discovered, but there is no active leak from the tank. If you know that the contamination occurred during the reporting year (RY), then report the leak as a release to land. However, if the leak did not occur during the RY, it should not be included in release reporting.

Metal mining facilities that close during the reporting year count all quantities of Section 313 chemicals manufactured, processed, or otherwise used during the entire reporting year. Similarly, all quantities of Section 313 chemicals released or managed as waste during the reporting year are reported in the appropriate section of the Form R. Section 313 chemicals in waste rock, tailings, or other wastes left on land are reported as releases to land (Part II, Section 5.5.4 of Form R).

Finally, the amount of leaks or spills onto pads or containment areas should not automatically be reported as released to land. The amount should be considered as treated or disposed depending on type of disposal activity. After releases to air, amounts cleaned up and disposed of off-site, amounts recycled, and amounts released to water are considered, then the amount remaining on the pad is considered to be released to land. Amounts spilled into containment that are directly reused within the same reporting year without requiring treatment prior to reuse are not subject to release reporting.

Fugitive or Non-Point Emissions (Part II, Section 5.1 of Form R)

Fugitive emissions can occur from almost any part of a facility's operation. Potential sources include the following:

- Normal leakage of valves, pump seals, flanges, connectors, and other devices
- Sampling, Packaging, Loading, and unloading of chemicals
- Cleaning and maintenance activities such as blowing out pipes
- Containers of raw materials, intermediates, or wastes
- Storage piles and spills
- Evaporation from cooling towers, ponds, surface

TSCREEN and SHEAR

To estimate emissions from tailings piles, the TSCREEN model can be used to correctly analyze toxic emissions and their subsequent dispersion from one of many different types of possible releases, including tailings piles. The computer program TSCREEN, A Model for Screening Toxic Air Pollutant Concentrations, should be used in conjunction with the "Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants (Revised)" (EPA, 1992a). With the use of these tools one can determine the type of release and the steps to be followed to simulate the release. TSCREEN can be downloaded at http://www.epa.gov/scram001.

- impoundments, and on-site wastewater management systems (including on-site sewers)
- Drum residues

Where actual monitoring or measurement data are not available, data sources and calculation methods that could be employed in estimating fugitive emissions include the following:

- Industrial Hygiene monitoring data
- AP-42 Emissions Factors (listed in Table 5-2)
- SOCMI emission factors (listed in Table 4-1)
- Facility-specific emission factors, models
- Mass balance (for volatile solvents)
- EPA models such as WATER8 for wastewater management systems
- Data from a leak detection and repair (LDAR) program
- Engineering calculations
- CHEMDAT8, TANKS, TSCREEN and SHEAR, etc

Additional models are provided on page 4-9 and in Appendix C.

Table 4-1. SOCMI AVERAGE EMISSION FACTORS*

Equipment type	Service[c]	Emission factors[a] (lbs/hr/source)
Valves	Gas Light liquid Heavy liquid	0.0131 0.00887 0.00051
Pump seals[b]	Light liquid Heavy liquid	0.0438 0.0190
Compressor seals	Gas	0.502
Pressure relief valves	Gas	0.229
Connectors	All	0.00403

Open-ended lines	All	0.0037
Sampling connections	All	0.033

*Protocol for Equipment Leak Emission Estimates (EPA, EPA-453/R-95-017)

a These factors are for total organic compound emissionsb The light liquid pump seal factor can be used to estimate the leak rate from agitator seals

c "Gas" is material in a gaseous state at operating conditions, "Light liquid" is material in a liquid state in which the sum of the concentration of individual constituents with a vapor pressure over 0.3 kilopascals (kPa) at 20 °C is greater than or equal to 20 weight percent, and "Heavy liquid" is material that is not defined as a gas or light liquid.

Stack or Point-Source Air Emissions (Part II, Section 5.2 of Form R)

Point-source air emissions can occur from numerous pieces of process equipment throughout a facility. Potential sources include the following:

- Air pollution control devices such as scrubbers, condensers, baghouses, etc.
- Storage tanks, process tanks, and waste tanks
- Process vessels such as reactors and distillation columns

Where actual monitoring or measurement data are not available, data sources and calculation methods that could be employed in estimating stack or point source emissions include the following:

- Air emission inventories
- Air permit applications
- Process and production data
- Emission factors from EPA and commercial models
- Engineering calculations

TANKS

The TANKS program is designed to estimate emissions of organic chemicals from several types of storage tanks. The calculations are performed according to EPA's AP-42, Chapter 12. After the user provides specific information concerning a storage tank and its liquid contents, the system produces a report which estimates the chemical emissions for the tank on an annual or partial year basis. The user can also determine individual component losses by using one of the specification options available in the program.

The TANKS program relies on a chemical database of over 100 organic liquids and a meteorological database which includes over 250 cities in the United States; users may add new chemicals and cities to these databases by providing specific information through system utilities. On-line help provides documentation and user assistance for each screen of the program. The TANKS program and manual can be downloaded from

Wastewater Discharges (Part II, Section 5.3 and 6.1 of Form R)

Discharges to a stream or water body are reported in Part II, Section 5.3 of Form R, while transfers to Publicly Owned Treatment Works (POTWs) are reported in Part II, Section 6.1 of Form R. Because the release estimation approach is similar for both types of wastewater discharges, they are discussed here together.

WATER8

A computer program, WATER8, is available for estimating the fate of organic compounds in various wastewater treatment units, including collection systems, aerated basins, and other units. WATER8 is written to run under DOS without the need to purchase other programs. WATER8 contains useful features such as the ability to link treatment units to form a treatment system, the ability for recycle among units, and the ability to generate and save site-specific compound properties. The WATER8 program and users manual can be downloaded from the world wide web at http://www.epa.gov/ttn/

A facility that discharges or has the potential to discharge water containing regulated wastes must operate under the terms of Federal, State, and/or local permits, such as a NPDES permit, or a POTW agreement. The permit(s) or agreement usually require measurements of the water volume and monitoring and analyses of some generalized wastewater parameters including concentrations of various constituents. In some cases, the constituent analyses required for permit compliance includes Section 313 chemicals. In these instances, releases can be calculated by multiplying the volume of wastewater released by the concentration of the chemical released. Releases discharged to a POTW should be reported as off-site transfers on Part II, Section 6.1 of Form R.

CHEMDAT8

Analytical models have been developed to estimate emissions of organic compounds via various pathways from wastewater and waste management units. Some of these models have been assembled into a spreadsheet called CHEMDAT8 for use on a PC. A user's guide for CHEMDAT8 is also available. Area emission sources for which models are included in the spreadsheet are as follows: nonaerated impoundments, which include surface impoundments and open top WWT tanks; aerated impoundments, which include aerated surface impoundments and aerated WWT tanks; disposal impoundments, which include non-aerated disposal impoundments; land treatment; and landfills. These models can be used to estimate the magnitude of site air emissions for regulatory purposes. The CHEMDAT8 program and manual can be downloaded from the world wide web at http://www.epa.gov/ttn/chief/software.html#water8 .

Based on the concentration and wastewater flow data available, an estimate of discharges to water can be calculated. Facilities should calculate the daily average discharges of a reportable Section 313 chemical in pounds and must use those estimates to determine the annual discharge in pounds per year. Using the daily concentration data available for the reportable chemical combined with the wastewater flow data for each of the sampling dates, calculate an estimate of pounds per day for each sampling date. After the calculations are made for each monitoring point (e.g., daily, monthly), the pounds discharged are averaged to determine an average daily discharge amount which would be multiplied by the number of days discharges were possible (e.g., 365 days a year).

If no monitoring data exist, NPDES permit applications or POTW agreements may provide information useful to estimating releases. Otherwise, process knowledge (or in some cases, mass balance) needs to be utilized to develop an estimate.

Example Calculation of Yearly Wastewater Discharge

A facility has monitoring data on discharges to water of xylene, a listed Section 313 chemical, and a Form R report is required. In this example, monitoring data on this chemical are only available for two days in the year. The daily quantities of pounds of xylene released for those two dates would then be divided by the number of sample dates to determine the daily average for the whole reporting year, which would be used to estimate the annual discharge of xylene in wastewater:

Date	Concentration (mg/l)	Flow (MGD)	Daily Discharge
3/1/96	1.0	1.0	8.33 lbs.
9/8/96	0.2	0.2	0.332 lbs.

Annual Calculation:
8.33 lbs. + 0.332 lbs./2 days x 365 days/year = 1580.82 lbs/yr

Section 313 reporting rules consider a waste stream containing a reportable acid (e.g., nitric acid) with a pH at 6 or above to be completely neutralized. Thus, if listed acids have been neutralized to pH at 6 or above before discharge to water or POTW, zero releases should be reported. Any excursions below a pH of 6 potentially constitute release of a reportable acid. For more information on calculating such discharges of mineral acids, see EPA's *Estimating Releases of Mineral Acid Discharges Using pH Measurements* (EPA 745/F-97-003, June 1991). Note that sulfuric and hydrochloric acids are only reportable in aerosol forms.

Releases should not be inadvertently "double counted." A single wastewater discharge should not be listed as both a release to water (on-site) and a discharge to POTW (off-site). Similarly, a release to land should not be listed as both a release to land (on-site) and a transfer to an off-site landfill.

Underground Injection On-Site (Part II, Section 5.4 of Form R)

A facility that has an underground injection well for waste disposal is regulated by Safe Drinking Water Act (SDWA) permits. The permit(s) usually require measurements of the waste volume and analyses of some generalized waste parameters including concentrations of various constituents. When the constituents for which the permit requires analyses include reportable Section 313 chemicals, releases via underground injection can be calculated by multiplying the volume of waste injected by the concentration of the chemical in the waste. Facilities must

report amounts of Section 313 chemicals injected into Class I wells (Part II, Section 5.4.1 of Form R) and amounts injected into Class II-V (Part II, Section 5.4.2 of Form R).

Release to Land On-Site (Part II, Section 5.5 of Form R)

In most circumstances involving the disposal of many Section 313 chemicals, land disposal is regulated by RCRA and state regulations. In part II, Section 5.5, TRI is concerned with the total amount of the specified reportable Section 313 chemical released to land, regardless of the potential for the chemical to leach from the disposed waste.

On-site disposal includes disposal in an on-site RCRA Subtitle C landfill (Part II, Section 5.5.1A of Form R), disposal in other on-site landfills (Part II, Section 5.5.1B of Form R), disposal in a land treatment/application farming unit (Part II, Section 5.5.2 of Form R), and disposal in a surface impoundment (Part II, Section 5.5.3 of Form R). Data concerning these types of "intentional" on-site disposal are usually readily available because facilities are required to monitor the quantity of waste and will have a waste profile that describes typical concentration ranges for waste constituents. In some cases, concentrations of constituents in the waste have been measured. If on-site waste treatment occurs prior to on-site land disposal, the treatment efficiency and a mass balance can be conducted to determine the quantity of a chemical that is land disposed. For example, a facility can determine the amount of the

Estimating Releases for Accidental Losses

Leaks, spills, and drips from the loading and transfer of chemicals received at the facility should be considered and reported in your release estimates. Data concerning specific incidents (such as notification reports or incident logs) should be used to estimate releases. Equations found in Section 6 of EPA's *Estimating Releases and Waste Treatment Efficiencies for the Toxic Chemical Release Inventory Form* (EPA 560/4-88-002, December 1987), provides guidance on calculating releases from chemical spills or leaks, including liquid discharges, fraction of discharge flashed, vaporization, two-phase discharges, and gas discharges.

EXAMPLE: A facility uses more than 10,000 pounds of ethylene glycol during the year to prevent freezing of coal piles. While unloading on a windless overcast day, a malfunction occurs and onsite personnel visually estimate that 50 gallons of ethylene glycol are spilled. Most of the spill remains on the pad, however, an estimated ten percent flows off the pad and onto the soil. Absorbent material used to remove the ethylene glycol from the concrete pad is transferred offsite for disposal. How would these releases be reported on the Form R? The density of ethylene glycol is 9.3 pounds per gallon, and the vapor pressure is 0.06 mm Hg at 68° F.

Quantity spilled = 50 gal x 9.3 lbs./gal = 465 lbs.
Amount spilled onto pad = 465 x 90% = 418.5 lbs.
Amount spilled onto soil = 465 x 10% = 46.6 lbs.

Air emissions of ethylene glycol are expected to be negligible due to the low vapor pressure and environmental conditions, provided response and cleanup are immediate. Therefore, the total amount spilled onto the concrete pad (418.5 pounds) is transferred offsite and should be reported in Sections 6.2, and the total amount spilled onto the soil (46.6

chemical present in the untreated waste, determine the efficiency of treatment in removing or destroying the chemical in the waste, account for other releases (i.e., fugitive emissions, leaks, spills, accidental releases, losses to air pollution control devices, etc.), and determine that the remainder is the quantity of the chemical land disposed.

Releases to land on-site/other disposal (Part II, Section 5.5.4 of Form R) include the amount of chemical released to land on site not covered by any of the above categories and include spills, leaks, or "unintentional" disposal, such as metal dust that is deposited onto soil. Incident logs or spill reports can provide useful information.

Transfers in Wastes to Other Off-site Locations (Part II, Section 6.2 of Form R)

Similar to on-site disposal, data concerning off-site waste transfers are usually readily available because facilities are required to monitor the quantity of waste and either measure concentrations of chemicals or develop a waste profile that describes typical concentration ranges. Under Section 313, off-site transfer estimates are based on the final, known disposition of the reportable Section 313 chemical in the waste sent off-site for further waste management. For example, a reportable Section 313 metal is contained in a waste solvent sent off-site for energy recovery purposes. Even though the waste stream as a whole has a sufficient heat value to warrant energy recovery, metals do not have a significant heat value and, therefore, cannot be combusted for energy recovery. Unless the facility had additional information on the fate of the reportable Section 313 metal in this waste, the facility must assume the metal is being disposed and should report the quantity sent off-site accordingly in Part II, Sections 6.2 and 8.1 of Form R.

Even wastes that were minimally processed, such as wastes that were repackaged, such as small containers removed from a lab pack that were not otherwise opened or managed, may need to be reported if the article exemption (as discussed in Section 2) is not applicable.

On-site Waste Treatment Methods and Efficiency (Part II, Section 7A of Form R)

In Section 7A, the following information must be reported:

- General waste stream types containing the Section 313 chemical being reported;
- Waste treatment methods or sequence used on all waste streams containing the Section 313 chemical;
- Range of concentration of the Section 313 chemical in the influent at the first step in a waste treatment system;

- Efficiency of the waste treatment method or sequence in destroying or removing the Section 313 chemical; and
- Indication of whether the efficiency estimate was based on actual operating data.

Report any waste treatment step through which the reportable Section 313 chemical passes regardless of treatment efficiency. Report all non-identical parallel steps and all sequential steps.

Waste treatment for the purpose of Section 7A is defined as removal of the Section 313 chemical from the waste through destruction, biological degradation, chemical conversion, or physical removal. Note that this definition of waste treatment is broader than the definition used in Part II, Section 8 of Form R (discussed later). Section 7A treatment efficiency is calculated as follows:

$$\textit{percent efficiency} = \frac{\textit{(input - output)}}{\textit{input}} \times 100\%$$

If your facility has a measurement of the pollutant concentration of input and output at the treatment unit, these data should be used to calculate the treatment efficiency. If these measurements are not available, data from literature or the equipment manufacturer can be used for estimation purposes. Equipment manufacturer data on treatment efficiencies often represent ideal operating conditions with an ideal waste matrix. Thus, you may want to adjust such data to account for downtime, process upsets, and other less than optimum conditions during the year that would result in lower efficiencies.

Estimates of treatment efficiencies by process for EPCRA Section 313 chemicals are available from the ATTIC database via modem from ATTIC by calling data number (703) 908-2138.

On-site Energy Recovery Processes (Part II, Section 7B of Form R)

In Section 7B, methods used to combust the Section 313 chemical in wastes for energy recovery are reported. Two conditions need to be met to report the combustion of a Section 313 chemical as energy recovery: (1) the chemical must have a heat of combustion high enough to support combustion (e.g., 5,000 BTU per pound or greater), and (2) must be combusted in a unit equipped with an energy recovery device, such as a waste heat boiler.

On-site Recycling Processes (Part II, Section 7C of Form R)

In Section 7C, methods used to recycle the Section 313 chemical in wastes are reported.

Source Reduction and Recycling Activities (Part II, Section 8 of Form R)

The following discussion for Sections 8.1 through 8.7 applies to the current reporting year (i.e., column B of Section 8 of the Form R).

Quantity Released (Part II, Section 8.1 of Form R)

The quantity reported in Section 8.1 is the quantity reported in all of Section 5 plus the quantity reported as sent off-site for disposal in Section 6.2 minus the quantity reported in Section 8.8 that was released or transferred off site for disposal:

§8.1 = §5 + §6.2 (disposal only) - §8.8 (release or off-site disposal only)

Section 6.2 disposal codes are M10, M71, M72, M73, M79, M90, M94, and M99. In addition, EPCRA Section 313 listed metals in waste streams sent off-site to POTWs or other off-site locations for treatment for destruction should be reported in Section 8.1, unless the facility has knowledge that the metal is being recovered.

Quantity Used for Energy Recovery On-site (Part II, Section 8.2 of Form R)

Estimate a quantity of the Section 313 chemical in wastes combusted for energy recovery on-site. This estimate should be the quantity of the chemical combusted in the process for which codes were reported in Section 7B. Test data from trial burns or other monitoring data may be used to estimate the quantity of the Section 313 chemical combusted for energy recovery purposes. If monitoring data are not available, vendor specifications regarding combustion efficiency may be used as they relate to the reportable Section 313 chemical. A quantity must be reported in Section 8.2 when a method of on-site energy recovery is reported in Section 7B and vice versa. Two conditions need to be met to report the combustion of a Section 313 chemical as energy recovery: the chemical (1) must have a heat of combustion high enough to support combustion (e.g., 5,000 BTU per pound or greater), and (2) must be combusted in a unit equipped with an energy recovery device, such as a waste heat boiler. Note that "NA" should be reported for Section 313 chemicals which are Halons (e.g., CFCs) and metals that do not have a heat of combustion sufficient to sustain combustion.

Quantity Used for Energy Recovery Off-site (Part II, Section 8.3 of Form R)

The quantity reported in Section 8.3 is the quantity reported in Section 6.2 for which energy recovery codes are reported. Section 6.2 energy recovery codes are M56 and M92. If a quantity is reported in Section 8.8, subtract any associated off-site transfers for energy recovery:

§8.3 = §6.2 (energy recovery) - §8.8 (off-site energy recovery)

Quantity Recycled On-site (Part II, Section 8.4 of Form R)

Estimate a quantity of the Section 313 chemical recycled in wastes on-site. This estimate should be the quantity of the chemical recycled in the process for which codes were reported in Section 7C. A quantity should be reported in Section 8.4 when a method of on-site recycling is reported in Section 7C and vice versa. To estimate this quantity, you should determine if operating data exist which indicate a recovery efficiency and use that efficiency value combined with throughput data to calculate an estimate. If operating data are unavailable, use available vendor specifications.

Quantity Recycled Off-site (Part II, Section 8.5 of Form R)

The quantity reported in Section 8.5 must be the same as the quantity reported in Section 6.2 for which recycling codes are reported. Section 6.2 recycling codes are M20, M24, M28, and M93. If a quantity is reported in Section 8.8, subtract any associated off-site transfers for recycling:

§8.5 = §6.2 (recycling) - §8.8 (off-site recycling)

Quantity Treated On-site (Part II, Section 8.6 of Form R)

Waste treatment in Section 8 is limited to the destruction or chemical conversion of the Section 313 chemical. The quantities reported in Section 8.6 will be those treated in a subset of the processes for which codes were reported in Section 7A, where treatment includes physical removal from a waste stream. To estimate this quantity, you should determine if operating data exist which indicate a treatment (e.g., destruction or chemical conversion of Section 313 chemical) efficiency and use that efficiency value combined with throughput data to calculate an estimate. If operating data are unavailable, use available vendor specifications. Section 7A must be completed if a quantity is entered in Section 8.6.

Quantity Treated Off-site (Part II, Section 8.7 of Form R)

The quantity reported in Section 8.7 must be the sum of the quantities reported in Section 6.2, for which treatment codes are reported, and the quantities reported in Section 6.1, which were sent to a POTW. Section 6.2 waste treatment codes are M40, M50, M54, M61, M69, and M95. If a quantity is reported in Section 8.8, subtract any associated off-site transfers for treatment:

§8.7 = §6.1 + §6.2 (treatment) - §8.8 (off-site treatment).

Because metals cannot be destroyed or chemically converted, metals cannot be reported as treated in Section 8. Quantities of metals reported in Section 6.1 and 6.2 as being treated should be reported in Section 8.1 (Quantity released), unless the facility has knowledge that the metal is being recovered.

Quantity Released to the Environment as a Result of Remedial Actions, Catastrophic Events, or One-time Events Not Associated with Production Processes (Part II, Section 8.8 of Form R)

The quantity reported in Section 8.8 is the quantity of the Section 313 chemical released directly into the environment or sent off-site for recycling, waste treatment, energy recovery, or disposal during the reporting year due to any of the following events:

(1) Remedial actions
(2) Catastrophic events such as earthquakes, fires, or floods
(3) One-time events not associated with normal or routine production processes

The quantity reported in Section 8.8 should not be included with quantities reported in Part II Sections 8.1 through 8.7 of Form R, but should be included in Part II , Sections 5 and 6 of Form R as appropriate.

Spills that occur as a routine part of production operations and could be reduced or eliminated by improved handling, loading, or unloading procedures are included in the quantities reported in Section 8.1 through 8.7 as appropriate. Releases and off-site transfers from remediation of a Section 313 chemical or an unpreventable accident unrelated to production (such as a hurricane) that cause a reportable Section 313 chemical to be released are reportable in Section 8.8.

On-site treatment, energy recovery, or recycling of Section 313 chemicals in wastes generated as a result of remedial actions, catastrophic events, or one-time events associated with production processes are not reported in Part II, Section 8.8 nor Sections 8.1 through 8.7 of Form R.

SECTION 5
CALCULATING RELEASE ESTIMATIONS AT METAL MINING FACILITIES

Mineral extraction is the process of accessing and removing ore from the ground. Depending on the nature and location of the ore deposit, one of three general methods of extraction may be employed. In surface mining, near-surface ore deposits are accessed by removing overlying rock and soil to expose the ore. In deeper deposits, the ore may be accessed by constructing horizontal tunnels and vertical shafts through which ore may be transported to the surface, in a method called underground mining. Finally, some deposits may be soluble or easily melted, or may occur as solution in their native form. These deposits may be extracted by using wells to pump a solution into the ore deposit and then to remove the solution to the surface in a process called solution mining. Releases associated with extraction are reportable, with the exception of releases from overburden, which are exempt under 40 CFR §372.38(h). Overburden is the unconsolidated material that overlies a deposit of useful materials or ores.

Once extracted from the mine, ore must pass through a variety of steps before the valued minerals are separated from the host rock material. Collectively called beneficiation, these steps typically include crushing and grinding to reduce the size of the ore; physical, chemical, or electrochemical methods to separate metals from host rock; and chemical or electrochemical steps to concentrate the metals. Following beneficiation, ores will be further processed by pyro-metallurgical process, such as smelting or refining.

BENEFICIATION

The remainder of this section focusses on calculating releases from beneficiation activities at metal mining operation in SIC Codes 1021, 1031, 1041, 1044, 1061, and 1099. The type and concentration of the target mineral and the nature of the host rock help to determine the beneficiation methods required to separate and concentrate the metals. As discussed earlier, **beneficiation is defined at 40 CFR §372.3, for the purposes of the TRI program, to mean the preparation of ores to regulate the size (including crushing and grinding) of the product, to remove unwanted constituents, or to improve the quality, purity, or grade of a desired product.**

To help mining facilities better understand the EPCRA Section 313 reporting requirements, this section presents a brief discussion of each of the activities specified in the definition of beneficiation found in RCRA, along with a discussion of release pathways and release estimation

techniques. Beneficiation is defined for the RCRA program (at 40 CFR §261.4(b)(7)) to include the following activities:

> *Crushing; grinding; washing; dissolution; crystallization; filtration; sorting; sizing; drying; sintering; pelletizing; briquetting; calcining to remove water and/or carbon dioxide; roasting, autoclaving, and/or chlorination in preparation for leaching (except where the roasting (and/or autoclaving and/or chlorination)/leaching sequence produces a final or intermediate product that does not undergo further beneficiation or processing); gravity concentration; magnetic separation; electrostatic separation; flotation; ion exchange; solvent extraction; electrowinning; precipitation; amalgamation; and heap, dump, vat, tank, and in situ leaching.*

The RCRA definition of beneficiation is used here as a guide only. Other activities performed at mining facilities may be considered beneficiation for the purposes of TRI reporting, and facilities must examine all on-site activities to determine whether the activity is exempt from reporting. The steps shown in Table 5-1 are broken into discussions of comminution and concentration/conditioning. Specific examples from mining operations are presented to aid the reader and assist in clarifying the concepts. Release estimations will be unique for each facility depending upon the extraction activities and beneficiation techniques used.

Table 5-1. Beneficiation Processes

Comminution	Concentration/Conditioning Processes		
	Physical	**Chemical**	**Heat**
Crushing Grinding Sorting Sizing	Gravity Concentration Magnetic Separation Electrostatic Separation Filtration	Leaching Flotation Solvent Extraction Electrowinning Precipitation Amalgamation Carbon Adsorption Ion Exchange	Roasting Sintering Autoclaving Pelletizing Briquetting Calcining

The beneficiation process begins with the comminution of ore (e.g., crushing, grinding, sorting and sizing of extracted ore in preparation for further activities to recover valued minerals). Following comminution, the ore may be subjected to one or more processes to concentrate or condition the material to concentrate the target metal or metal compounds. The following sections describe these major processes used. Facilities utilizing unique or innovative processes involving Section 313 chemicals subject to reporting, which are not described in this manual, should consider all potential pathways for release of the chemicals.

COMMINUTION

As part of the preparatory process, ores need to be transported from the excavation site to the comminution site. Based on the type of terrain, transportation can be by rubber-tired vehicle, rail, train, or by conveyer. Particulate emissions can be generated from specific transportation activities, particularly during loading and unloading. For metals and metal compounds present in ores at or above the *de minimis* levels, these particulate emissions should be reported as fugitive emissions (Part II, Section 5.1 of Form R) provided an activity threshold is met or exceeded. While the motor vehicle exemption applies to activities involving maintaining motor vehicles operated by the facility, this exemption does not extend to releases from ores being transported in the vehicles within the facility's boundaries.

Crushing

Crushing reduces the rock size from over 1 meter in diameter to approximately 10-25 mm in diameter using compression and impact methods. Most crushing operations are dry or use water sprays to reduce dust emissions. Some mines use water-flush crushers. In most mines, extracted ores are transported to separate crushing operations, while some mines conduct the crushing operations directly in the mines, whether underground or in an open pit.

Sorting and Sizing

The size of the crushed ore is regulated by size separators. Grizzlies are typically used only for very coarse material, while vibrating and shaker screens are more commonly used overall. To facilitate further processing, the crushed ore is mixed with water to form a slurry. Sorting and sizing can result in the release of particulate matter. For metals and metal compounds present in ores at or above the *de minimis* levels, these particulate emissions should be reported as fugitive emissions (Part II, Section 5.1 of Form R) provided an activity threshold is met or exceeded.

Grinding

Grinding is the further size reduction of crushed materials to allow the required liberation of the ore metal. While the specific method of liberation is determined by the mineralogy of the ore deposit and the prevailing economic conditions, grinding is done through abrasion and impact in tumbling mills using steel rods or balls, ceramic pebbles, or large pieces of the ore itself. The tumbling mills are lined with abrasion-resistant materials to minimize wear of the mill shell. Liners and other media (e.g., steel rods or balls, ceramic pebbles) are replaced periodically and are mostly composed of cast or rolled steel and rubber. Grinding is a continuous process, which is either wet or dry. Wet grinding is most common and is usually the choice if subsequent processing is wet.

In most cases, no chemicals that would trigger TRI reporting are added to this process. Since crushing, grinding, and milling generally does not result in concentration of any of the Section 313 metal constituents, these processes should have no impact on the threshold determination. However, these operations can result in air emissions (dusts in particular) that may be reportable if the initial concentrations of the Section 313 metal constituents meet or exceed the specified *de minimis* levels, provided an activity threshold is met or exceeded.

Air Emissions from Preparation, Storage, and Transport

Crushing, grinding, and milling operations will result in the release of fume or dust. In general, a dry process will create a dust (includes all particle sizes) and a wet process creates a fume. Wet processes (i.e., those that use wet ores or add water) are less likely to generate appreciable dust emissions. Other mining operations, such as drying of concentrates, storage, and transfer and loading of mined materials or final product also will result in generation of fume or dust.

Water sprays, with or without additives, are common for transport, transfer points, and crushing. Other emissions from mills may be are controlled through wet scrubbers or baghouses. Scrubbers and baghouses will appreciably reduce the fume and dust emissions to a constant outlet concentration. Many mines will have measured data and/or estimates concerning particulate emissions through the air permitting process. Table 5-2 presents particulate emission factors for metal beneficiation activities. (Although much less commonly used, dry grinding processes that involve air conveying and air classification usually use dry cyclones for efficient product recovery. The emissions factors presented in Table 5-2 are for emissions after product recovery cyclones.) Mining operations can use either measured data or the emission factors in Table 5-2 to estimate releases of metals and metal compounds through fume and dust. This can be accomplished by combining either actual emissions data or emission factors shown in Table 5-2 with knowledge of the concentration of the metal in the ore to estimate the quantity of parent metal released.

Using this information and the calculations presented below, facilities can calculate reasonable estimates of their fugitive and stack air emissions (Part II, Sections 5.1 and 5.2) as well as estimate the efficiency of any air control equipment to treat Section 313 chemicals (Part II, Section 7A of Form R).

Table 5-2. Emission Factors for Metal Mining Operations

Source	Filterable[b,c]			
	PM[a]	RATING	PM-10	RATING
Low-moisture ore[e]				
Primary crushing (SCC 3-03-024-01)[d]	0.5	C	0.05	C
Secondary crushing (SCC 303-024-02)[d]	1.2	D	ND	
Tertiary crushing (SCC 3-03-024-03)[d]	2.7	E	0.16	E
Wet grinding	Neg		Neg	
Dry grinding with air conveying and/or air classification (SCC 3-03-024-09)[e]	28.8	C	26	C
Dry grinding without air conveying and/or air classification (SCC 3-03-024-10)[e]	2.4	D	0.31	D
Drying--all minerals except titanium/zirconium sands (SCC 3-03-024-11)[f]	19.7	C	12	C
Drying--titanium/zirconium with cyclones (SCC 3-03-024-11)[f]	0.5	C	ND	C
Material handling and transfer--all minerals except bauxite (SCC 3-03-024-04)[g]	0.12	C	0.06	C
Material handling and transfer--bauxite/alumina (SCC 3-03-024-04)[g,h]	1.1	C	ND	
High-moisture ore[e]				
Primary crushing (SCC 3-03-024-05)[d]	0.02	C	0.01	C
Secondary crushing (SCC 3-03-024-06)[d]	0.05	D	0.02	D
Tertiary crushing (SCC 3-03-024-07)[d]	0.06	E	0.02	E
Wet grinding	Neg		Neg	
Dry grinding with air conveying and/or air classification (SCC 3-03-024-09)[e]	28.8	C	26	C
Dry grinding without air conveying and/or air classification (SCC 3-03-024-10)[e]	2.4	D	0.31	D
Drying--all minerals except titanium/zirconium sands (SCC 3-03-024-11)[f]	19.7	C	12	C
Drying--titanium/zirconium with cyclones (SCC 3-03-024-11)[f]	0.5	C	ND	
Material handling and transfer--all minerals except bauxite (SCC 3-03-024-08)[g]	0.01	C	0	C
Material handling and transfer--bauxite/alumina (SCC 3-03-024-08)[g,h]	ND		ND	

Source: AP-42. References: *Metallic Mineral Processing Plants - Background Information for Proposed Standards (Draft)*, EPA Contract No. 68-02-3063, TRW, Research Triangle Park, NC, 1981; Telephone communication between E.C. Monnig, TRW, Environmental Division, and R. Beale, Associated Minerals, Inc., May 17, 1982; Written communication from W.R. Chalker, DuPont, Inc. to S.T. Cuffe, U.S. Environmental Protection Agency, Research Triangle Park, NC, December 21, 1981; Written communication from P.H. Fournet, Kaiser Aluminum and Chemical Corporation, to S.T. Cuffe, U.S. Environmental Protection Agency, Research Triangle Park, NC, March 5, 1982. Factors represent uncontrolled emissions unless otherwise noted; controlled emission factors are discussed in Section 11.24.3. All emission factors are in lb/ton of material processed unless noted.

[a] PM emissions do not equate to quantity of listed chemical. Such determinations require knowledge of the percent concentration of the target chemical in the ore. SCC = Source Classification Code. Neg = negligible. ND = no data.

[b] Filterable PM is that PM collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train.

[c] Defined in Section 11.24.2.

[d] Based on weight of material entering primary crusher.

[e] Based on weight of material entering grinder; emission factors are the same for both low-moisture and high-moisture ore because material is usually dried before entering grinder.

[f] Based on weight of material exiting dryer; emission factors are the same for both high-moisture and low-moisture ores; SO_x emissions are fuel dependent (see Chapter 1); NO_x emissions depend on burner design and combustion temperature (see Chapter 1).

[g] Based on weight of material transferred; applies to each loading or unloading operation and conveyor belt transfer point.

[h] Bauxite with moisture content as high as 15 to 18% can exhibit the emission characteristics of low- moisture ore; use low-moisture ore emission factor for bauxite unless material exhibits obvious sticky, nondusting characteristics.

**Emission Factor Quality Ratings for Table 5-2 are as follows:

A Excellent. Factor is developed from A- and B-rated source test data taken from many randomly chosen facilities in the industry population. The source category population is sufficiently specific to minimize variability.

B Above average. Factor is developed from A- or B-rated test data from a "reasonable number" of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As with an A rating, the source category population is sufficiently specific to minimize variability.

C Average. Factor is developed from A-, B-, and/or C-rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As with the A rating, the source category population is sufficiently specific to minimize variability.

D Below average. Factor is developed from A-, B- and/or C-rated test data from a small number of facilities, and there may be reason to suspect that these facilities do not represent a random sample of the industry. There also may be evidence of variability within the source population.

E Poor. Factor is developed from C- and D-rated test data, and there may be reason to suspect that the facilities tested do not represent a random sample of the industry. There also may be evidence of variability within the source category population.

Washing

Washing typically can occur as part of a specific process, such as vat leaching or recovery of copper through cementation. Washing and wash water residuals are discussed as part of the processes where it may be used. Other washing activities can include washing of muds from ore prior to crushing and grinding. If Section 313 metals or metal compounds are present above the *de minimis* threshold in the ore, washing may result in the release of waters containing the metal which should be reported as releases to water (Part II, Section 5.3 of Form R).

CONCENTRATION/CONDITIONING

Following comminution, the reduced size ore is further processed to concentrate or condition the target metals in the ore. Three primary techniques are used: (1) physical; (2) chemical; and/or (3) heat. Processes can be used alone or together in series. Each of these is described below.

Physical

Gravity Concentration

The most common method of gravity concentration uses a slurry of ore and water that passes over a series of riffles to catch the heavier gold and silver particles, but gold pans, sluices, shaking tables, or jigs also can be used. For example, in instances where gold or silver occurs as larger particles in the ore, its high density relative to other minerals makes gravity a practical means of concentration. No Section 313 chemicals are likely to be involved in this operation as it is strictly a physical beneficiation method. However, if the *de minimis* concentration for silver compounds is met or exceeded, any silver contained in discharged tailings from the gravity process would have to be reported, provided an activity threshold is met or exceeded.

Magnetic Separation

Magnetic separation employs the magnetic susceptibility of metals to affect separation. Most typically, magnetic separation is used to remove highly magnetic minerals, such as iron, but it may also be used for removal of chromium and other metals or minerals. In magnetic separation, the ground ores pass over or under a magnetic field, causing the non-magnetic materials to be removed first, followed at a second point by the magnetic materials. Operations may be conducted on dry ore or wet slurries. Magnetic separation is a physical separation technique. No Section 313 chemicals are likely to be added to this operation. However, if the *de minimis* concentration for a metal or metal compound is met or exceeded, any metal or metal compound contained in discharged tailings from the magnetic separation process would have to be reported, provided an activity threshold is met or exceeded.

Electrostatic Separation

Electrostatic separation utilizes the differences in electrical conductivity, triboelectic effect, or polarity between various minerals to affect separation of target metals from other materials. This process is used in only limited situations. In this process, finely ground ore typically is passed through an ion bombardment field in a rotating grounded drum. Low conductivity materials stick to the drum and high conductivity materials are thrown from the drum. No Section 313 chemicals are likely to be added to this operation as it is strictly a physical beneficiation method. However, if the *de minimis* concentration for a metal or metal compound is met or exceeded, any metal or metal compound contained in discharged tailings from the process would have to be reported, provided an activity threshold is met or exceeded.

Filtration

Water-borne ore fines will be allowed to settle, promoting separation of water and sludge. This step, typically referred to as thickening, is then followed by filtration. Filtration can be used to dewater both slurries and tailings. Various types of filters can be used, including drum, plate and frame, or belt filter. Filter aids may be used to improve filtration. Dewatering will result in the generation of water, which can either be recycled on-site or discharged. If an activity threshold is met or exceeded, wastewater discharges would be reported either as discharges to stream or water bodies (Form R, Part II, Section 5.3) or discharges to public owned treatment works (Form R, Part II, Section 6.1) Non-product filter cake, filtrate, and spent filter cloths may be generated and require further management. These releases may be reportable if, for example, they are managed in a landfill (Form R, Part II, Section 5.5.1).

Flotation

Flotation is the process where particles of one or more minerals are preferentially wetted by various agents causing the hydrophobic minerals to adhere to the surfaces of air bubbles. As the air bubbles rise to the surface, the desired minerals are transported to the surface and are removed by skimming. Figure 5-1 provides an overview of the flotation process. This step could also generate particulate and other chemical air emissions. Froth flotation, is the principal separation technique for copper, lead, molybdenum, zinc, phosphate, and other metals. Flotation typically will be conducted using air, water, the prepared ore, flotation agents specially selected to recover the desired metal, and regulating agents (e.g., pH regulators, activators, depressants, dispersants, or flocculants).

The product of flotation is a metal concentrate that is filtered to remove excess water and flotation agents prior to transfer or sale to a smelting/refining operation. Beneficiation of lead/zinc ores is primarily done through the use of flotation of sulfide ores. The flotation process is comparable to flotation processes found at other types of metal mines, including copper.

Most flotation or regulating agents (e.g., pine oil, lime) do not contain Section 313 chemicals above *de minimis* concentrations, however some flotation agents could. Examples from the copper industry are shown in Table 5-3 and examples from the lead/zinc industry are shown in Table 5-4. These lists are not exhaustive and a facility needs to review its own processes to identify all reagents used. MSDSs provided by the supplier should identify Section 313

chemicals present in the flotation agents and the concentration of the chemical. If a activity threshold is exceeded for any Section 313 chemical in a flotation agent (e.g., 10,000 pounds or more of the Section 313 chemical are otherwise used), a Form R is required for that chemical and releases must be estimated. Residual flotation agents would generally be disposed of in the tailings impoundment.

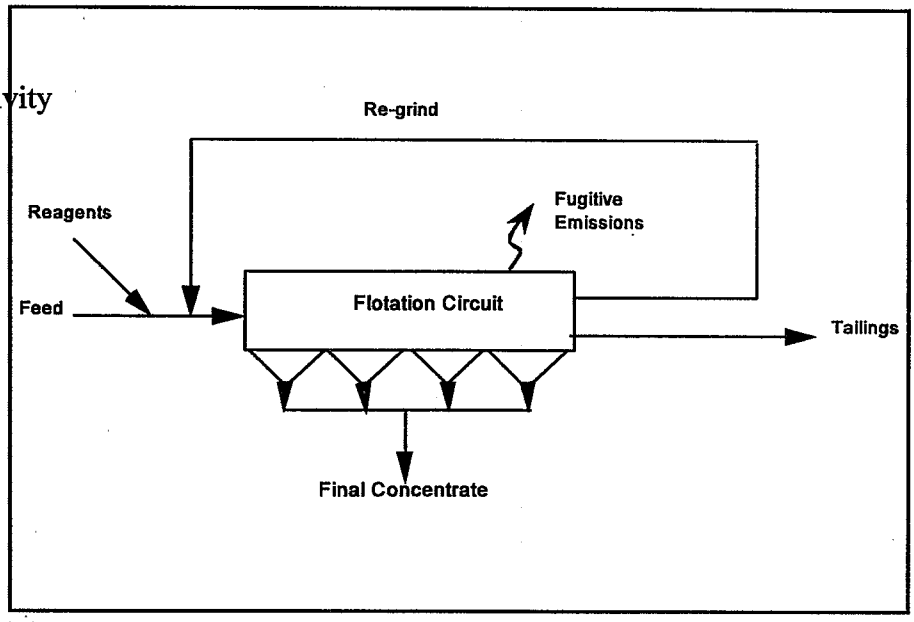


Figure 5-1. Flotation Process

Table 5-3. Common Copper Beneficiation Flotation Agents Containing Section 313 Chemicals

Flotation Agent	Section 313 Chemical
Copper sulfate	Copper compounds
Cresylic acid	Cresols
Nokes reagent	Arsenic compounds
Kerosene	Cyclohexane, naphthalene, benzene, xylene, and ethyl benzene (all typically below de minimis)
Polyacrylamide	Acrylamide (monomer)
Sodium cyanide	Cyanide compounds
Sodium ferrocyanide	Cyanide compounds
Zinc sulfate	Zinc compounds

Table 5-4. Common Lead/Zinc Benefication Flotation Agents Containing Section 313 Chemicals

Flotation Agent	Section 313 Chemical
Copper Sulfate	Copper Compound
Cresylic Acid	Cresols
Sodium Ferrocyanide	Cyanide Compounds
Sodium dichromate	Chromium compounds
Zinc Sulfate	Zinc Compounds

After the target minerals are separated, tailings (wastewater in a slurry) may be sent to a thickener. The thickener process may also use chemicals to accelerate settling and agglomeration. Some of these chemicals are disposed of either along with the tails or separately. Water from the thickeners is often recycled to the mill.

The tailings are generally sent to a tailings impoundment. If the surface impoundment is intended for storage or holding without discharge, the surface impoundment is the final disposal method, and quantities of Section 313 chemicals in the tailings would be reported in Part II, Section 5.5.3 of Form R. Quantities of the Section 313 chemical released to surface impoundments that are used merely as part of a wastewater treatment process generally are not reported as disposal in a surface impoundment. However, in this case, any seepage of the Section 313 chemical from the impoundment that occurred during the reporting year would be reported as a release to land on-site/other disposal (Part II, Section 5.5.4 of Form R). Also, if the impoundment accumulates sludges containing the Section 313 chemical, you must include an estimate for Section 5.5.3 unless the sludges are removed and otherwise disposed (in which case they should be reported under the appropriate section of the Form R for the year in which they were disposed, provided an activity threshold has been exceeded). In either case, Section 313 chemicals contained in discharges from surface impoundments to surface water would be reported as a discharge to a receiving stream or water body (Part II, Section 5.3 of Form R). Even those facilities subject to "zero discharge" requirements of 40 CFR Part 440, Subpart J may have authorized discharges due to the stormwater exemption, and these would be reportable as well.

Facilities must report on the final disposition of chemicals released during the reporting year. If, for example, a facility released 1,000 pounds of a Section 313 chemical to land in 1998, of which 500 pounds migrated into the air or was discharged to water during 1998, the facility would

report 500 pounds released to land and 500 pounds released to air or water for 1998. The facility does not, however, report amounts that are emitted or migrate from one media to another in subsequent years. For example, if a facility disposes 1,000 pounds of a Section 313 chemical to land in 1998, and 500 pounds of this is discharged to water in 1999, the facility reports 1,000 pounds released to land in 1998, and does not report the 500 pounds discharged to water in 1999 on the Form R.

Information on the facility's water balance and composition of its tailings water, solids, and discharge can be used to calculate estimates of surface impoundment releases and waste management activities .

Chemical Processes

Leaching

Leaching is a chemical technology that allows for recovery of metals from the ore. This section discusses five leaching processing used in the metal mining industry. Heap or tank/vat leaching is the predominant method of beneficiating gold and silver where dilute solutions of sodium or potassium cyanide are used as leaching agents to extract these precious metals from ore. In copper mining, dilute sulfuric acid is used as the leaching agent in dump leaching processes. Also copper is leached *in situ* by the introduction of lixiviants[2] directly into the ore deposit via injection wells, and metal-laden solution is recovered via production wells. Finally, bioleaching uses microbes or bacteria to leach metals from low-grade sulfide ores.

Heap Leaching

In heap leaching, the leaching solution is applied directly to crushed or run-of-mine ore on open heaps as shown in Figure 5-2. Such ore may be crushed, if necessary, but is not ground. A heap is built on an impervious pad, usually with a synthetic liner, to control and collect the leach solution. A typical heap leach cycle may last three months. Although the cyanide may be applied at concentrations below 0.1 percent, solid cyanide salts usually are purchased in bulk, and mixed with water to meet the desired concentration. In this case, there would be no *de minimis* exemption for cyanide compounds.

[2]Lixiviants aid in the separation of soluble and insoluble constituents by percolation.

Following the heap leaching, the ore is rinsed with mine water or mill wastewater, with or without chlorine or other chemicals, to remove most of the remaining cyanide solutions and gold- and silver-cyanide complex. Following heap rinsing, the spent ore becomes waste. The spent ore is either left as is or, in the case of "on-off" heap leach pads, is disposed in dumps similar to those used for waste rock. The spent ore will contain small quantities of waste water from rinsing the ore, residual cyanide, and metal compounds including metal-cyanide complexes. For non-exempt Section 313 chemicals (i.e., at or above *de minimis* levels) for which an activity threshold has been exceeded, quantities remaining in the heap would be reported as released to land on site (Part II, Section 5.5 of Form R) when the heap is closed. Sometimes heap leaching is performed in combination with zinc precipitation (discussed later) as shown in Figure 5-3.

Tank and Vat Leaching

The crushed and ground ore slurry can be further processed by tank or vat leaching. For the purposes of this document, no difference exists in the processes used in a tank- or vat-based operation. Tank or vat leaching is typically a batch process, although continuous leaching processes can be used. For copper, vat leaching produces a pregnant leach solution (PLS) of sufficient copper concentration for electrowinning (30 to 50 kg/m^3 of copper). If the iron content of the solution is high, the PLS may be sent for solvent extraction prior to electrowinning. Gold mining also uses vat leaching to recover gold.

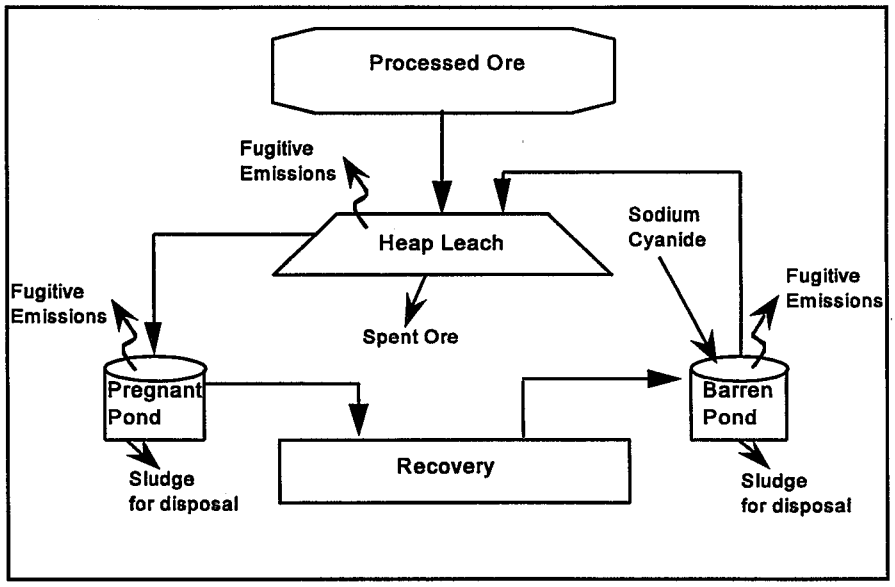


Figure 5-2. Heap Leaching

Agitated vat leaching refers to the relatively rapid leaching of fine particles of ore or roaster calcines with a strong sulfuric acid solution in agitated tanks. The tanks are stirred or agitated by mechanical devices or piped steam discharge. Compressed air is used in a similar method of agitation in a pressurized tank operation. A pressurized operation is used in several different types of autoclaves.

Some facilities at one time used chlorine to pre-treat the ore. This practice may no longer be in use. If it is practiced, this activity would be considered otherwise use and reporting would be required if 10,000 pounds or more are used in the reporting year. This process would be expected to result in fugitive air emissions of chlorine (Part II, Section 5.1 of Form R).

As is shown in Figure 5-4, in the gold mining industry, fine ore is mixed with lime and cyanide solution before it is sent to leach tanks. As metals are removed from ore in vat leach circuits

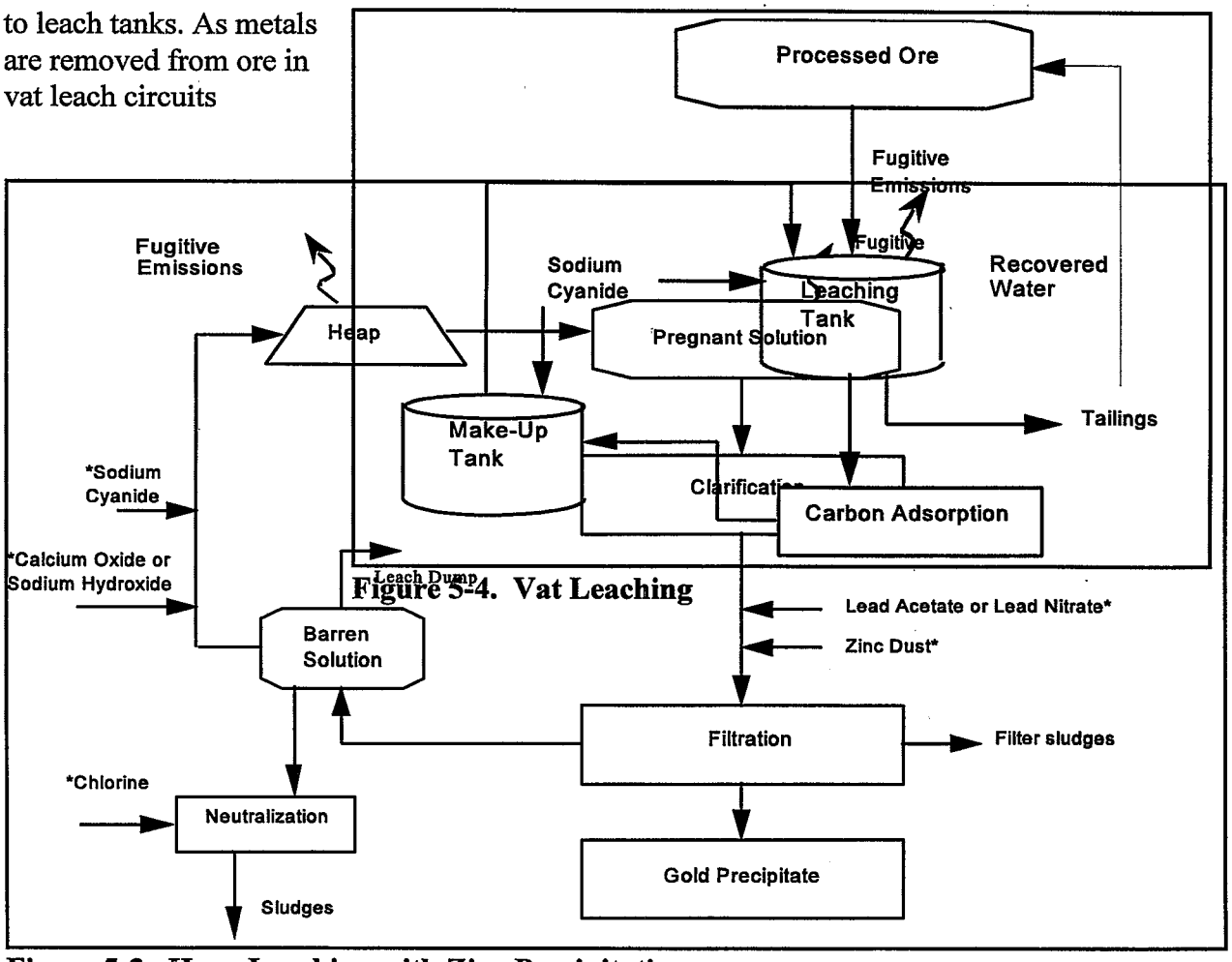


Figure 5-4. Vat Leaching

Figure 5-3. Heap Leaching with Zinc Precipitation

(recycle loops), a slurry of spent ore tailings is removed. Tailings slurry, typically discharged to unlined or lined earthen dam impoundments, may contain residual cyanide, metal-cyanide complexes, and dissolved metals. The residual metals content of the tailings as well as residual cyanide levels must be reported if threshold levels have previously been met or exceeded. Reporting amounts placed in surface impoundments is discussed previously in this section, under the heading "***Flotation***". The quantity and composition of the tailings is monitored to ensure the efficiency of the leaching process. These data can be used to estimate the quantity of reportable Section 313 chemicals discharged to land on site. The metal-cyanide solution is sent to recovery, typically by activated carbon, as described in the following section on recovery techniques.

After the tailings have settled, water can be recovered for reuse or treatment followed by discharge. Prior to wastewater discharge, cyanide may require destructive treatment. This treatment would be reportable as on-site treatment (Part II, Section 8.6 of Form R). This treatment can use a number of chemicals including, chlorine and ozone, which are Section 313 chemicals. If chemicals are otherwise used above the 10,000-pound activity threshold, then a Form R would be required for that chemical. In some cases, operators may employ cyanide destruction technologies for detoxification of tailings slurry prior to discharge to disposal impoundments, thus, reported releases may be minimal or zero. Monitoring data to support permit compliance should be available to determine if any releases to water (Part II, Section 5.3 of Form R) or discharges to surface impoundment (Part II, Section 5.5.3 of Form R) occurred and to estimate the quantity of cyanide compounds treated (Part II, Section 8.6 of Form R).

Dump Leaching

In the dump leaching process, the crushed ore is treated by a leaching agent, typically dilute sulfuric acid. The sulfuric acid is dripped, sprinkled, or sprayed onto the dump of ore. This spraying could result in the manufacture of sulfuric acid in the aerosol form. Note that the *de minimis* exemption does not apply to the manufacture of Section 313 chemicals. If greater than 25,000 pounds of sulfuric acid in the aerosol form are manufactured, then the manufacturing threshold has been exceed and a Form R report is required. Releases of sulfuric acid in the aerosol form must be estimated and reported as well.

This leaching process results in the production of pregnant leach solution (PLS), a dilute solution of copper sulfate, which may also contain other metals. While the goal is to collect all PLS for copper recovery, some of the PLS may escape the collection system (e.g., through seepage). Provided an activity threshold is met or exceeded, the copper (or other Section 313 chemicals) in the lost PLS would be reported as released to land on-site: other disposal (Part II, Section 5.5.4 of Form R). The facility water balance and the PLS characterization should provide this information. Releases to water could also occur during large storm events. Some of the PLS may

also be lost to a nearby water body through drainage or storm water. Monitoring required by NPDES permits may provide useful data to estimate these releases. The copper in this PLS would be reported as discharged to a receiving stream or water body (Part II, Section 5.3 of Form R). Once the leaching process is completed, the dump would cease to be a process unit and the remaining copper (and/or other Section 313 chemicals) in the dump would be reported as being released to land on site (Part II, Section 5.5 of Form R).

Barren solution (raffinate) is an acidic aqueous solution that has been stripped of copper but still has some carryover of the organic extraction/diluent used in the solvent extraction operation. The raffinate generated at hydrometallurgical plants is typically stored in ponds and recycled to the dump leaching operation.

In Situ Leaching

Less commonly used, *in situ* leaching involves the removal of target metals directly from deep-lying deposits of undisturbed ore or from porous or permeable deposits in disturbed ore through in-ground leaching. Section 313 chemicals added to deposits for the purposes of *in-situ* leaching should be reported as a releases to land on-site/other disposal (Part II, Section 5.5.4 of Form R) provided an activity threshold is met or exceeded. Facilities are responsible only for reporting of the final disposition of chemicals released during the reporting year. If, for example, 1,000 pounds of a Section 313 chemicals were used during the year for *in-situ* leaching in 1998, this amount need not be reported again in 1999.

Bioleaching

Microbial (or bacterial) leaching is appropriate for low-grade sulfide ores at dump, heap leach, underground, and possibly *in situ* leaching operations. The organisms use atmospheric carbon dioxide (CO_2) for cell growth and oxidize ferrous iron and sulfides to obtain energy for growth. Sulfuric acid is a product of the organism's metabolism. For example, for chalcopyrite (a copper sulfide), the bacteria first oxidizes the ferrous iron to ferric iron. Ferric iron then chemically oxidizes the sulfide. This bacteria can also assist in the oxidation of sulfur to sulfuric acid. Sufficient dissolved oxygen must be available during these oxidation reactions. The other main growth requirements are ammonia, nitrogen, phosphate, and a suitable temperature (approximately 30°C) and acidity (approximate pH of 2.0). Some metals, such as mercury, silver, and (possibly) molybdenum, can retard or stop leaching by inhibiting or killing the bacteria. The chemical and biochemical reactions involved in microbial leaching of copper ore/minerals are complex and facilities using this technology are best equipped to determine the chemical conversions taking place.

The *de minimis* exemption does not apply to the manufacture of Section 313 chemicals. If greater than 25,000 pounds of sulfuric acid in the aerosol form are manufactured, then the manufacturing threshold has been exceeded and a Form R report is required. Releases of sulfuric acid in the aerosol form must be estimated.

Solvent Extraction

Solvent extraction typically is used to extract and concentrate valued minerals from the pregnant leach solutions. In the copper industry, the pregnant leaching solution from dump leaching is pumped to a solvent extraction plant, where it is mixed with an organic solvent in a mixer. The organic solvent consists of a chelating agent such as alkylated 8-hydroxyquinoline (not a Section 313 chemical) in an organic diluent such as kerosene (containing many petroleum hydrocarbons, including Section 313 chemicals such as benzene, xylenes, ethylbenzene). In the mixer, the PLS is contacted with the organic solvent, forming a copper-organic complex. The PLS after it has been stripped of the copper is referred to as barren leachate solution or raffinate and is recirculated back to the leaching units. Sludge can accumulate in the solvent extraction/electrowinning system and is land disposed periodically. Copper (or other Section 313 chemicals) in the sludge would be reported as being released to land on site (Part II, Section 5.5 of Form R) provided an activity threshold is met or exceeded.

In the second stage, the loaded organic solution is stripped of the copper with concentrated sulfuric acid solution to produce a solution of copper sulfate for electrowinning. Then the mixture is allowed to separate in settling tanks, where the barren organic solution can be recycled to the solvent extraction stage. The copper-enriched, strong electrolyte flows from the stripping stages to the strong-electrolyte tanks, where it is pumped to the electrolyte filters for removal of the entrained organics or solids. The clarified, strong electrolyte flows to electrolyte circulation tanks, where it becomes electrolyte for the electrowinning tankhouse. Because the acid electrolyte is heated, sulfuric acid in the aerosol form may be manufactured in this process as well. The *de minimis* exemption does not apply to the manufacture of Section 313 chemicals. If greater than 25,000 pounds of sulfuric acid in the aerosol form are manufactured, then the manufacturing threshold has been exceeded and a Form R report is required. Releases of sulfuric acid in the aerosol form must be estimated.

The solvent extraction process generates a "sludge," or, as it is known in the copper industry, "crud" or "gunk." This sludge consists of a solids and a stabilized emulsion of organic and aqueous solutions from solvent extraction. It is generated at the organic/aqueous interface in the settlers and is periodically removed from the system, and centrifuged or otherwise treated to remove the organics, which are returned to the solvent extraction circuit for reuse. The composition of the sludge may be monitored or a typical concentration may be available from a

waste profile. This composition information along with the quantity of the sludge disposed on site can be used to estimate the quantity of the reportable Section 313 chemicals (e.g., metals and cyanide compounds) present in the sludge. These estimates would be reported as disposal to land on site (Part II, Section 5.5 of Form R) provided an activity threshold is met or exceeded.

Electrowinning

Electrowinning is used to remove metals from electrolyte solutions. Electric current is passed through a tank and the target metal adheres to the anode or the cathode, enabling recovery. In the copper industry, electrowinning uses anodes made of lead (a Section 313 chemical) or stainless steel (which typically contains chromium and nickel, both Section 313 chemicals, above *de minimis* concentrations). Use of these anodes constitutes otherwise use. If more than 0.5 pounds of a Section 313 chemical from the anodes is released, and not recycled, over the course of the reporting year, the article exemption could not apply to the anodes and the quantity of Section 313 chemicals in the anodes added to the process during the reporting year would need to be counted towards the threshold determination.

In the copper industry, the electrochemical reaction at the lead-based anodes produces oxygen gas and sulfuric acid by electrolysis. Copper often is plated on thin-copper starting sheets. The cathode copper is then shipped to a mill for fabrication. The spent acid is generally recycled and pumped back to the leaching operation. A small amount of wastewater may be discharged as a bleed stream to surface water (or the bleed stream may be reused elsewhere in the facility). If the bleed stream is discharged, the copper (and possibly other reportable Section 313 chemicals) in the bleed stream would be reported as released to water (Part II, Section 5.3 of Form R) provided an activity threshold is met or exceeded.

Electrowinning also is used in the gold/silver industry. In this case, the process starts with the placement of concentrated solution in tanks that commonly contain steel wool to act as a cathode. A current is passed through the solution causing the gold/silver to exchange with iron. Gold/silver on the cathode and any sludge in the tank is fluxed with various fluxing agents and subsequently melted for casting as bullion. If the quantity of a Section 313 chemical used in this process meets or exceeds the 10,000-pound otherwise use threshold, a Form R report for that chemical would be required.

Sludge can accumulate in electrowinning tanks. Any sludge generated from this process that contains reportable Section 313 chemicals for which an activity threshold is met or exceeded must be included in the Form R. The sludge is typically shipped off site for recovery of other metals from the sludge. Metals in this sludge may be reportable as off-site waste transfers for

recycling (Part II, Sections 6.2 and 8.5 of Form R) if thresholds for these metals have been exceeded.

Spent electrolyte is generated during electrowinning activities. Historically, electrolyte is sent through a stripping step and is subsequently discharged to a tailings pond. Any reportable Section 313 chemicals in the spent electrolyte disposed of in the tailings pond would need to be reported as a release to land on site (Part II, Section 5.5 of Form R) provided an activity threshold is met or exceeded.

Over time, electrolyte in the electrowinning cells becomes laden with soluble impurities and copper. When this occurs, the solution is removed and replaced with pure electrolyte (to maintain the efficiency of the solution and prevent coprecipitation of the impurities at the cathode). Purification of the spent electrolyte is done by electrowinning in liberator cells. Liberator cells are similar to normal electrolytic cells, but they have lead anodes in place of copper anodes. The electrolyte is cascaded through the liberator cells, and an electric current is applied. For example, during copper electrowinning, copper in the solution is deposited on copper starting sheets. As the copper in the solution is depleted, the quality of the copper deposit is degraded. Liberator cathodes containing impurities (such as antimony) are returned to the smelter to be melted and cast into anodes. Purified electrolyte is recycled to the electrolytic cells. Any bleed electrolyte usually is neutralized with mill tailings and disposed of in a tailings pond (U.S. EPA 1994). Any reportable Section 313 chemicals in the bleed electrolyte disposed of in the tailings pond would need to be reported as a release to land on site (Part II, Section 5.5 of Form R) provided an activity threshold is met or exceeded.

Zinc Precipitation

Zinc precipitation is well suited to gold ores containing large amounts of silver. The pregnant solution is filtered, and dissolved oxygen is removed. Metallic zinc dust is added to exchange with the gold of the gold-cyanide complex. In some cases, cyanide and lead nitrate or lead acetate is added to increase the reaction rate. Gold precipitates and is filtered from the solution for smelting into dore (unrefined gold). Zinc dust, zinc compounds, lead compounds, and nitrate compounds are listed Section 313 chemicals and if the use of any of these chemicals exceeds the 10,000 pound otherwise use threshold, then a Form R is required.

Amalgamation

Amalgamation is the technique of wetting metallic gold with mercury to form an alloy. While this process is not used in large-scale operations in the U.S., use of 10,000 pounds or more of mercury and/or mercury compounds in a calendar year would require Form R reporting.

Activated Carbon Adsorption

Activated carbon adsorption is used to remove the desired metals from pregnant solutions, most commonly in gold recovery. The metal is adsorbed onto the carbon and, after the carbon is loaded with metals, the metal is desorbed. In gold beneficiation, the gold is removed with a solution of cyanide and sodium hydroxide to form a concentrated pregnant solution. Figure 5-5 presents an overview of the activated carbon adsorption process. Activated carbon can be regenerated, and this activity can occur either on-site or off-site using a variety of different means. If the carbon is sent off-site for regeneration and contains any amount of cyanide (or other reportable Section 313 chemical), this would be reported as an off-site transfer in Part II, Section 6 of Form R and the appropriate part of Part II, Section 8 of Form R provided an activity threshold is met or exceeded. For on-site regeneration, the common method employed is an acid rinse using a hydrochloric and/or nitric acid solution. Nitric acid is a Section 313 chemical and the quantity of nitric acid used would be applied to the otherwise use threshold. This process is not likely to generate hydrochloric acid in the aerosol form, but if it did, the quantity of hydrochloric acid aerosol would be applied to the "manufacture" and "otherwise use" thresholds. The resulting spent acid wash solutions are neutralized with high-pH tailings slurry, dilute sodium hydroxide solution, or water. If the hydrochloric or nitric acids are used at or above the 10,000-pound otherwise use threshold, a Form R report is required and the quantity neutralized is reportable as on-site treatment (Part II, Section 8.6 of Form R). Following neutralization, the wash water, which may contain silver or other Section 313 chemicals, is disposed of in the tailings impoundment. This disposal of silver or other reportable Section 313

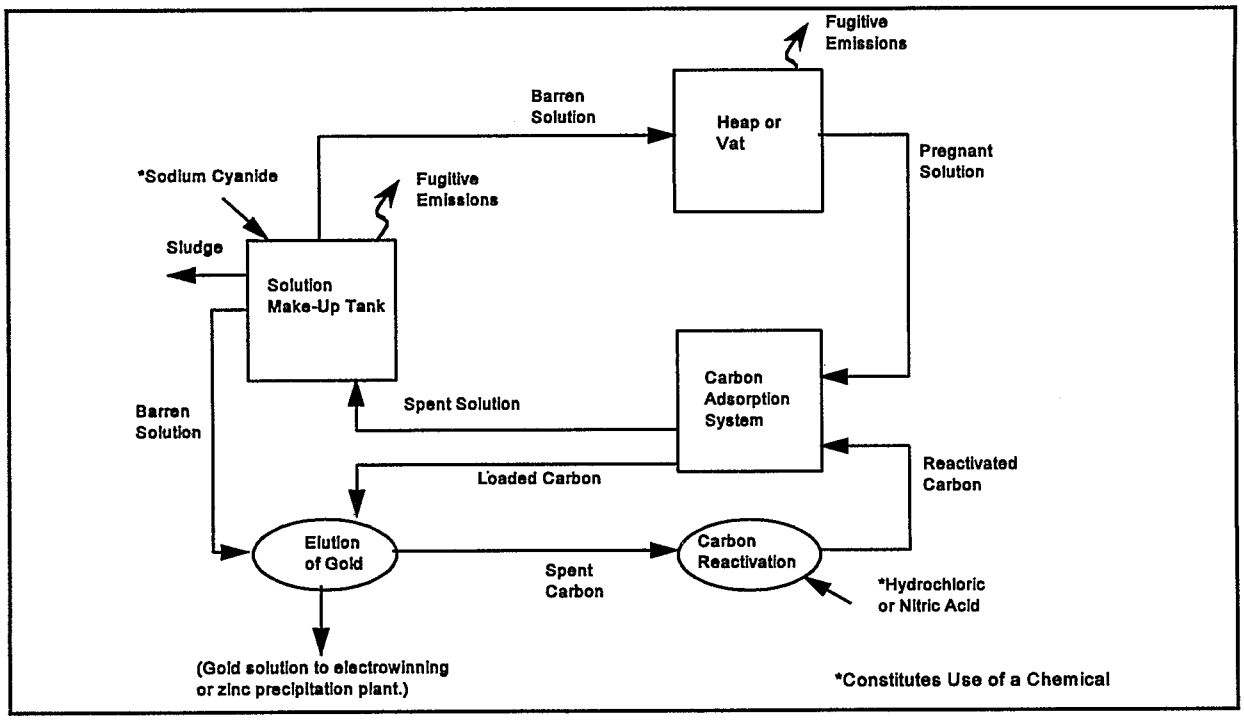


Figure 5-5. Activated Carbon Adsorption

chemical would be reported as a release to land on-site/surface impoundment (Part II, Section 5.5.3) provided an activity threshold is met or exceeded.

If the mine is using nitric acid to regenerate their carbon beds, a spent acid wash solution containing nitric acid will be generated. Quantities of acid neutralized to a pH of 6 or above are reported as zero, however, the facility could have pH exceedences, which must be reported if the otherwise use threshold is exceeded.

After the carbon is regenerated, it is returned to the recovery system. The use and regeneration process gradually decreases the performance of the carbon. Approximately 10 percent of the carbon is lost during each process necessitating the addition of fresh carbon. The spent carbon may contain cyanide, precious metals, or other Section 313 chemicals. Generally, spent carbon is sold as a product to facilities that then recover the precious metals. When sold as a product, spent carbon shipped off site is not reportable as a release. If the spent carbon is transferred offsite for disposal, however, the quantities of any Section 313 chemicals would be reported in Part II, Section 6.2, of the Form R provided an activity threshold is met or exceeded.

Ion Exchange

Metals and metal compounds can be recovered from water-ore slurries using either anionic or cationic resins in a packed column to effect recovery. Loaded resins are separated from the remaining water-residue slurry, and the target metals are recovered from the resins. Wastewater discharges would be reported either as discharges to stream or water bodies (Form R, Part II, Section 5.3) or discharges to public owned treatment works (Form R, Part II, Section 6.1) provided an activity threshold is met or exceeded. Non-recoverable resins may be generated and require further management. These releases may be reportable if, for example, they are managed in a landfill (For R, Part II, Section 5.5.1) provided an activity threshold is met or exceeded.

Heat Processes

Calcining

Calcining is a heat process used to remove excess water and carbon dioxide from ore slurries. It can also be used to oxidize aluminum hydroxide ($Al(OH)_3$) precipitate to alumina or to dry sulfide ore slurries prior to roasting. (Kirk Othmer, 4th Ed., Vol. 16, 1995.) Ore is calcined in a rotary kiln. Potential releases from calcining include calcines offgases, which contain airborne particulate emissions (Form R, Part II, Section 5.2); and calcines residues, which are usually collected and recycled back into the calcinator (Form R, Part II, Section 7C).

Roasting

Roasting can be used as a preparative step to reduce metal sulfides to metal oxides or sulfates, thus improving the opportunity for recovery of the target metal. Roasting involves heating sulfide ores in air to convert them to oxide ores. In effect, roasting oxidizes the sulfur in the ore generating sulfur dioxide that can be captured and converted into sulfuric acid. Roasting temperatures are dependent on the mineralogy of the ore, but range as high as several hundred degrees Celsius. Sulfur dioxide (SO_2) and sulfur trioxide (SO_3) can be formed from this reaction. Complete roasting may remove all sulfides, while incomplete roasting will result in the conversion of excess sulfur. Finally, water-soluble sulfates can be produced through a sulfated roast. Sulfuric acid can be recovered from the produced sulfur dioxide and sulfur trioxide. This recovery could result in the manufacture of sulfuric acid in the aerosol form. If the facility uses this recovered sulfuric acid on-site, it must apply the amount used to the otherwise use threshold. As discussed earlier, the *de minimis* exemption does not apply to the manufacture of Section 313 chemicals. If greater than 25,000 pounds of sulfuric acid in the aerosol form are manufactured,

then the manufacturing threshold has been exceeded and a Form R report is required. Releases of sulfuric acid in the aerosol form must be estimated.

Sintering

Concentrates of certain metals (e.g., lead, zinc) may also be sintered after metal recovery operations and before smelting and refining. Sintering involves the partial fusion of ore concentrates into an agglomerated material suitable for processing operations. The sinter material is typically a crushed and graded structure of porous cellular solids.

Autoclaving

Autoclaving (pressure oxidation) is a relatively new technique that operates at lower temperatures than roasting. Autoclaving uses pressurized steam to start the reaction and oxygen to oxidize sulfur-bearing minerals. Heat released from the oxidation of sulfur sustains the reaction.

Pelletizing and Briquetting

Similar to sintering, pelletizing is the agglomeration of ores after comminution through balling in a disk, drum, or cone and heating to a temperature of approximately 1300°C and briquetting is agglomeration through formation in to briquettes. During the heating, excess water is vaporized. Pelletizing is found almost exclusively in the recovery of iron for blast furnaces and steelmaking furnaces. Facilities that conduct iron mining (SIC Code 1011) are not subject to the reporting requirements of EPCRA Section 313.

APPENDIX A
ALPHABETICAL LISTING OF SECTION 313 CHEMICALS

CAS No.	CHEMICAL NAME	De Minimis Conc	Appx VIII	RCRA UTS	RCRA Code
4080-31-3	1-(3-Chloroallyl)-3,5,7-triaza-1-azoniaadamantane chloride	1.0			
354-11-0	1,1,1,2-Tetrachloro-2-fluoroethane (HCFC-121a)	1.0			
630-20-6	1,1,1,2-tetrachloroethane	1.0	X	X	U208
71-55-6	1,1,1-Trichloroethane (Methyl chloroform)	1.0	X	X	U226
354-14-3	1,1,2,2-Tetrachloro-1-fluoroethane (HCFC-121)	1.0			
79-34-5	1,1,2,2-Tetrachloroethane	1.0	X	X	U209
79-00-5	1,1,2-Trichloroethane	1.0	X	X	U227
13474-88-9	1,1-Dichloro-1,2,2,3,3-pentafluoropropane (HCFC-225cc)	1.0			
812-04-4	1,1-Dichloro-1,2,2-trifluoroethane (HCFC-123b)	1.0			
111512-56-2	1,1-Dichloro-1,2,3,3,3-pentafluoropropane (HCFC-225eb)	1.0			
1717-00-6	1,1-Dichloro-1-fluoroethane (HCFC-141b)	1.0			
57-14-7	1,1-Dimethyl hydrazine	0.1	X		U098
5124-30-1	1,1-Methylene bis(4-isocyanatocyclohexane)	1.0			
96-18-4	1,2,3-Trichloropropane	0.1	X	X	
120-82-1	1,2,4-Trichlorobenzene	1.0	X	X	
95-63-6	1,2,4-Trimethylbenzene	1.0			
106-88-7	1,2-Butylene oxide	1.0			
96-12-8	1,2-Dibromo-3-chloropropane (DBCP)	0.1	X	X	U066
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	0.1	X	X	U067
422-44-6	1,2-Dichloro-1,1,2,3,3-pentafluoropropane (HCFC-225bb)	1.0			
354-23-4	1,2-Dichloro-1,1,2-trifluoroethane (HCFC-123a)	1.0			
431-86-7	1,2-Dichloro-1,1,3,3,3-pentafluoropropane (HCFC-225da)	1.0			
1649-08-7	1,2-Dichloro-1,1-difluoroethane (HCFC-132b)	1.0			
95-50-1	1,2-Dichlorobenzene	1.0	X	X	U070
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	0.1	X	X	U077
540-59-0	1,2-Dichloroethylene	1.0			
78-87-5	1,2-Dichloropropane	1.0	X	X	U083
122-66-7	1,2-Diphenylhydrazine (Hydrazobenzene)	0.1	X	X	U109
95-54-5	1,2-Phenylenediamine	1.0		X	
615-28-1	1,2-Phenylenediamine dihydrochloride	1.0			
38661-72-2	1,3-Bis(methylisocyanate)cyclohexane	1.0			
106-99-0	1,3-Butadiene	0.1			
507-55-1	1,3-Dichloro-1,1,2,2,3-pentafluoropropane (HCFC-225cb)	1.0			
136013-79-1	1,3-Dichloro-1,1,2,3,3-pentafluoropropane (HCFC-225ea)	1.0			
541-73-1	1,3-Dichlorobenzene	1.0	X	X	U071
542-75-6	1,3-Dichloropropylene	0.1	X		U084
123-61-5	1,3-Phenylene diisocyanate				
108-45-2	1,3-Phenylenediamine	1.0			
10347-54-3	1,4-Bis(methylisocyanate)cyclohexane	1.0			
2556-36-7	1,4-Cyclohexane diisocyanate	1.0			
764-41-0	1,4-Dichloro-2-butene	1.0	X		U074
106-46-7	1,4-Dichlorobenzene	0.1	X	X	U072
123-91-1	1,4-Dioxane	0.1	X	X	U108
104-49-4	1,4-Phenylene diisocyanate				
624-18-0	1,4-Phenylenediamine dihydrochloride	1.0			
3173-72-6	1,5-Naphthalene diisocyanate	1.0			
82-28-0	1-Amino-2-methylanthraquinone	0.1			
35691-65-7	1-Bromo-1-(bromomethyl)-1,3-propanedicarbonitrile	1.0			
354-25-6	1-Chloro-1,1,2,2-tetrafluoroethane (HCFC-124a)	1.0			
75-68-3	1-Chloro-1,1-difluoroethane (HCFC-142b)	1.0			

5522-43-0	1-Nitropyrene	1.0			
16938-22-0	2,2,4-Trimethylhexamethylene diisocyanate	1.0			
128903-21-9	2,2-Dichloro-1,1,1,3,3-pentafluoropropane (HCFC-225aa)	1.0			
306-83-2	2,2-Dichloro-1,1,1-trifluoroethane (HCFC-123)	1.0			
2655-15-4	2,3,5-Trimethylphenyl methylcarbamate	1.0			
422-48-0	2,3-Dichloro-1,1,1,2,3-pentafluoropropane (HCFC-225ba)	1.0			
78-88-6	2,3-Dichloropropene	1.0			
15646-96-5	2,4,4-Trimethylhexamethylene diisocyanate	1.0			
95-95-4	2,4,5-Trichlorophenol	1.0	X	X	
88-06-2	2,4,6-Trichlorophenol	0.1	X	X	
94-75-7	2,4-D [Acetic acid, (2,4-dichloro-phenoxy)-]	1.0	X	X	U240
53404-37-8	2,4-D 2-ethyl-4-methylpentyl ester	0.1			
1928-43-4	2,4-D 2-ethylhexyl ester	0.1			
1929-73-3	2,4-D butoxyethyl ester	0.1			
94-80-4	2,4-D butyl ester	0.1			
2971-38-2	2,4-D chlorocrotyl ester	0.1			
94-11-1	2,4-D isopropyl ester	0.1			
1320-18-9	2,4-D propylene glycol butyl ether ester	0.1			
2702-72-9	2,4-D sodium salt	0.1			
94-82-6	2,4-DB	1.0			
615-05-4	2,4-Diaminoanisole	0.1			
39156-41-7	2,4-Diaminoanisole sulfate	0.1			
95-80-7	2,4-Diaminotoluene	0.1	X		
120-83-2	2,4-Dichlorophenol	1.0	X	X	U081
75790-87-3	2,4'-Diisocyanatodiphenyl sulfide	1.0			
105-67-9	2,4-Dimethylphenol	1.0	X	X	U101
51-28-5	2,4-Dinitrophenol	1.0	X	X	P048
121-14-2	2,4-Dinitrotoluene	1.0	X	X	U105
541-53-7	2,4-Dithiobiuret	1.0	X		P049
120-36-5	2,4-DP	0.1			
576-26-1	2,6-Dimethylphenol	1.0			
606-20-2	2,6-Dinitrotoluene	1.0	X	X	U106
87-62-7	2,6-Xylidine	0.1			
53-96-3	2-Acetylaminofluorene	0.1	X	X	U005
117-79-3	2-Aminoanthraquinone	0.1			
52-51-7	2-Bromo-2-nitropropane-1,3-diol (Bronopol)	1.0			
2837-89-0	2-Chloro-1,1,1,2-tetrafluoroethane (HCFC-124)	0.1			
75-88-7	2-Chloro-1,1,1-trifluoroethane (HCFC-133a)	1.0			
532-27-4	2-Chloroacetophenone	1.0			
110-80-5	2-Ethoxyethanol	1.0	X		U359
149-30-4	2-Mercaptobenzothiazole (MBT)	1.0			
109-86-4	2-Methoxyethanol	1.0			
75-86-5	2-Methyllactonitrile	1.0	X		P069
109-06-8	2-Methylpyridine	1.0	X		U191
88-75-5	2-Nitrophenol	1.0		X	
79-46-9	2-Nitropropane	0.1	X		U171
90-43-7	2-Phenylphenol	1.0			
422-56-0	3,3-Dichloro-1,1,1,2,2-pentafluoropropane (HCFC-225ca)	1.0			
91-94-1	3,3'-Dichlorobenzidine	0.1	X		U073
612-83-9	3,3'-Dichlorobenzidine dihydrochloride	0.1			
64969-34-2	3,3'-Dichlorobenzidine sulfate	0.1			
119-90-4	3,3'-Dimethoxybenzidine	0.1	X		U091
91-93-0	3,3'-Dimethoxybenzidine-4,4'-diisocyanate				

20325-40-0	3,3'-Dimethoxybenzidine dihydrochloride (o-Dianisidine dihydrochloride)	0.1			
111984-09-9	3,3'-Dimethoxybenzidine hydrochloride (o-Dianisidine hydrochloride)	0.1			
91-97-4	3,3'-Dimethyl-4,4'-diphenylene diisocyanate				
119-93-7	3,3'-Dimethylbenzidine (o-Tolidine)	0.1	X		U095
612-82-8	3,3'-Dimethylbenzidine dihydrochloride (o-Tolidine dihydrochloride)	0.1			
41766-75-0	3,3'-Dimethylbenzidine dihydrofluoride (o-Tolidine dihydrofluoride)	0.1			
460-35-5	3-Chloro-1,1,1-trifluoropropane (HCFC-253fb)	1.0			
563-47-3	3-Chloro-2-methyl-1-propene	0.1			
542-76-7	3-Chloropropionitrile	1.0	X		P027
55406-53-6	3-Iodo-2-propynyl butylcarbamate	1.0	X	X	
101-80-4	4,4'-Diaminodiphenyl ether	0.1			
4128-73-8	4,4'-Diisocyanatodiphenyl ether	1.0			
80-05-7	4,4'-Isopropylidenediphenol	1.0			
101-14-4	4,4'-Methylenebis(2-chloroaniline) (MBOCA)	0.1	X	X	U158
101-61-1	4,4'-Methylenebis(N,N-dimethyl)benzenamine	0.1			
101-77-9	4,4'-Methylenedianiline	0.1			
139-65-1	4,4'-Thiodianiline	0.1			
534-52-1	4,6-Dinitro-o-cresol	1.0	X	X	P047
60-09-3	4-Aminoazobenzene	0.1			
92-67-1	4-Aminobiphenyl	0.1	X	X	
60-11-7	4-Dimethylaminoazobenzene	0.1	X	X	U093
75790-84-0	4-Methyldiphenylmethane-3,4-diisocyanate	1.0			
92-93-3	4-Nitrobiphenyl	0.1			
100-02-7	4-Nitrophenol	1.0	X	X	U170
3697-24-3	5-Methylchrysene				
99-59-2	5-Nitro-o-anisidine	1.0			
99-55-8	5-Nitro-o-toluidine	1.0	X	X	U181
57-97-6	7,12-Dimethylbenz(a)anthracene				U094
194-59-2	7H-Dibenzo(c,g)carbazole				
71751-41-2	Abamectin [Avermectin B1]	1.0			
30560-19-1	Acephate (Acetylphosphoramidothioic acid O,S-dimethyl ester)	1.0			
75-07-0	Acetaldehyde	0.1			U001
60-35-5	Acetamide	0.1			
75-05-8	Acetonitrile	1.0	X	X	U003
98-86-2	Acetophenone	1.0	X		U004
62476-59-9	Acifluorfen, sodium salt [5-(2-Chloro-4-(trifluoromethyl)phenoxy)-2-nitrobenzoic acid, sodium salt]	1.0			
107-02-8	Acrolein	1.0	X	X	P003
79-06-1	Acrylamide	0.1	X	X	U007
79-10-7	Acrylic acid	1.0			U008
107-13-1	Acrylonitrile	0.1	X	X	U009
15972-60-8	Alachlor	1.0			
116-06-3	Aldicarb	1.0	X		P070
309-00-2	Aldrin [1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-(1.alpha.,4.alpha.,4a.beta.,5.alpha.,8.alpha.,8a.beta.)-]	1.0	X		P004
107-18-6	Allyl alcohol	1.0	X		P005
107-05-1	Allyl chloride	1.0	X	X	
107-11-9	Allylamine	1.0			

319-84-6	alpha-Hexachlorocyclohexane	1.0		X	
134-32-7	alpha-Naphthylamine	0.1	X		U167
7429-90-5	Aluminum (fume or dust)	1.0			
1344-28-1	Aluminum oxide (fibrous form)	1.0			
20859-73-8	Aluminum phosphide	1.0	X		P006
834-12-8	Ametryn (N-Ethyl-N'-(1-methylethyl)-6-(methylthio)-1,3,5,-triazine-2,4-diamine)	1.0			
33089-61-1	Amitraz	1.0			
61-82-5	Amitrole	0.1	X		U011
7664-41-7	Ammonia	1.0			
101-05-3	Anilazine [4,6-Dichloro-N-(2-chlorophenyl)-1,3,5-triazin-2-amine]	1.0			
62-53-3	Aniline	1.0	X	X	U012
120-12-7	Anthracene	1.0		X	
7440-36-0	Antimony	1.0	X	X	
7440-38-2	Arsenic	0.1	X	X	
1332-21-4	Asbestos (friable)	0.1			
1912-24-9	Atrazine (6-Chloro-N-ethyl-N'-(1-methylethyl)-1,3,5-triazine-2,4-diamine)	0.1			
7440-39-3	Barium	1.0	X	X	
22781-23-3	Bendiocarb [2,2-Dimethyl-1,3-benzodioxol-4-ol methylcarbamate]	1.0	X	X	
1861-40-1	Benfluralin (N-Butyl-N-ethyl-2,6-dinitro-4-(trifluoromethyl) benzenamine)	1.0			
17804-35-2	Benomyl	1.0	X	X	
56-55-3	Benz(a)anthracene				U018
98-87-3	Benzal chloride	1.0	X	X	U017
55-21-0	Benzamide	1.0			
71-43-2	Benzene	0.1	X	X	U019
92-87-5	Benzidine	0.1	X		U021
218-01-9	Benzo(a)phenanthrene				
50-32-8	Benzo(a)pyrene				U022
205-99-2	Benzo(b)fluoranthene				
205-82-3	Benzo(j)fluoranthene				
207-08-9	Benzo(k)fluoranthene				
189-55-9	Benzo(rst)pentaphene				U064
98-07-7	Benzoic trichloride (Benzotrichloride)		X		U023
98-88-4	Benzoyl chloride	1.0			
94-36-0	Benzoyl peroxide	1.0			
100-44-7	Benzyl chloride	1.0	X		P028
7440-41-7	Beryllium	0.1	X	X	P015
91-59-8	beta-Naphthylamine	0.1	X	X	U168
57-57-8	beta-Propiolactone	0.1			
82657-04-3	Bifenthrin	1.0			
92-52-4	Biphenyl	1.0			
108-60-1	Bis(2-chloro-1-methylethyl)ether	1.0	X		U027
111-91-1	Bis(2-chloroethoxy) methane	1.0	X	X	U024
111-44-4	Bis(2-chloroethyl) ether	1.0	X	X	U025
103-23-1	Bis(2-ethylhexyl) adipate				
542-88-1	Bis(chloromethyl) ether	0.1	X		P016
56-35-9	Bis(tributyltin) oxide	1.0			
10294-34-5	Boron trichloride	1.0			
7637-07-2	Boron trifluoride	1.0			

314-40-9	Bromacil (5-Bromo-6-methyl-3-(1-methylpropyl)-2,4-(1H,3H)-pyrimidinedione)	1.0			
53404-19-6	Bromacil, lithium salt (2,4-(1H,3H)-Pyrimidinedione, 5-bromo-6-methyl-3 (1-methylpropyl), lithium salt)	1.0			
7726-95-6	Bromine	1.0			
353-59-3	Bromochlorodifluoromethane (Halon 1211)	1.0			
75-25-2	Bromoform (Tribromomethane)	1.0	X	X	U225
74-83-9	Bromomethane (Methyl bromide)	1.0	X	X	U029
75-63-8	Bromotrifluoromethane (Halon 1301)	1.0			
1689-84-5	Bromoxynil (3,5-Dibromo-4-hydroxybenzonitrile)	1.0			
1689-99-2	Bromoxynil octanoate (Octanoic acid, 2,6-dibromo-4-cyanophenyl ester)	1.0			
357-57-3	Brucine	1.0	X		P018
141-32-2	Butyl acrylate	1.0			
123-72-8	Butyraldehyde	1.0			
4680-78-8	C.I. Acid Green 3	1.0			
6459-94-5	C.I. Acid Red 114	0.1			
569-64-2	C.I. Basic Green 4	1.0			
989-38-8	C.I. Basic Red 1	1.0			
1937-37-7	C.I. Direct Black 38	0.1			
28407-37-6	C.I. Direct Blue 218	0.1			
2602-46-2	C.I. Direct Blue 6	0.1			
16071-86-6	C.I. Direct Brown 95	0.1			
2832-40-8	C.I. Disperse Yellow 3	1.0			
81-88-9	C.I. Food Red 15	1.0			
3761-53-3	C.I. Food Red 5	0.1			
3118-97-6	C.I. Solvent Orange 7	1.0			
842-07-9	C.I. Solvent Yellow 14	1.0			
97-56-3	C.I. Solvent Yellow 3	1.0			
492-80-8	C.I. Solvent Yellow 34 (Auramine)	0.1	X		U014
128-66-5	C.I. Vat Yellow 4	1.0			
7440-43-9	Cadmium	0.1	X	X	
156-62-7	Calcium cyanamide	1.0			
133-06-2	Captan [1H-Isoindole-1,3(2H)-dione, 3a,4,7,7a-tetrahydro-2-[(trichloromethyl)thio]-]	1.0			
63-25-2	Carbaryl [1-Naphthalenol, methylcarbamate]	1.0	X	X	
1563-66-2	Carbofuran	1.0	X	X	
75-15-0	Carbon disulfide	1.0	X	X	P022
56-23-5	Carbon tetrachloride	0.1	X	X	U211
463-58-1	Carbonyl sulfide	1.0			
5234-68-4	Carboxin (5,6-Dihydro-2-methyl-N-phenyl-1,4-oxathiin-3-carboxamide)	1.0			
120-80-9	Catechol	1.0			
2439-01-2	Chinomethionat (6-Methyl-1,3-dithiolo[4,5-b]quinoxalin-2-one)	1.0			
133-90-4	Chloramben [Benzoic acid, 3-amino-2,5-dichloro-]	1.0			
57-74-9	Chlordane [4,7-Methanoindan, 1,2,3,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-]	0.1	X	X	U036
115-28-6	Chlorendic acid	0.1			
90982-32-4	Chlorimuron ethyl (Ethyl-2-[[[(4-chloro-6-methoxyprimidin-2-yl)-carbonyl]-amino]sulfonyl]benzoate)	1.0			
7782-50-5	Chlorine	1.0			
10049-04-4	Chlorine dioxide	1.0			
79-11-8	Chloroacetic acid	1.0			

108-90-7	Chlorobenzene	1.0	X	X	U037
510-15-6	Chlorobenzilate [Benzeneacetic acid,4-chloro-.alpha.-(4-chlorophenyl)-.alpha.-hydroxy-, ethyl ester]	1.0	X	X	
75-45-6	Chlorodifluoromethane (HCFC-22)	1.0			
75-00-3	Chloroethane (Ethyl chloride)	1.0		X	
67-66-3	Chloroform	0.1	X	X	U044
74-87-3	Chloromethane (Methyl chloride)	1.0	X	X	U045
107-30-2	Chloromethyl methyl ether	0.1	X		U046
76-06-2	Chloropicrin	1.0			
126-99-8	Chloroprene	1.0	X	X	U210
63938-10-3	Chlorotetrafluoroethane	1.0			
1897-45-6	Chlorothalonil [1,3-Benzenedicarbonitrile, 2,4,5,6-tetrachloro-]	1.0			
75-72-9	Chlorotrifluoromethane (CFC-13)	1.0			
5598-13-0	Chlorpyrifos methyl (O,O-Dimethyl-O-(3,5,6-trichloro-2-pyridyl)phosphorothioate)	1.0			
64902-72-3	Chlorsulfuron (2-Chloro-N-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]benzenesulfonamide)	1.0			
7440-47-3	Chromium	0.1	X	X	
7440-48-4	Cobalt	0.1			
7440-50-8	Copper	1.0			
8001-58-9	Creosote	0.1			U051
1319-77-3	Cresol (mixed isomers)	1.0	X		U052
4170-30-3	Crotonaldehyde	1.0	X		U053
98-82-8	Cumene	1.0			U055
80-15-9	Cumene hydroperoxide	1.0			U096
135-20-6	Cupferron [Benzeneamine, N-hydroxy-N-nitroso, ammonium salt]	0.1			
21725-46-2	Cyanazine	1.0			
1134-23-2	Cycloate	1.0	X	X	
110-82-7	Cyclohexane	1.0			U056
108-93-0	Cyclohexanol	1.0			
68359-37-5	Cyfluthrin (3-(2,2-Dichloroethenyl)-2,2-dimethylcyclopropanecarboxylic acid, cyano(4-fluoro-3-phenoxyphenyl)methyl ester)	1.0			
68085-85-8	Cyhalothrin (3-(2-Chloro-3,3,3-trifluoro-1-propenyl)-2,2-Dimethylcyclopropanecarboxylic acid cyano(3-phenoxyphenyl) methyl ester)	1.0			
28057-48-9	d-trans-Allethrin [d-trans-Chrysanthemic acid of d-allethrone]	1.0			
533-74-4	Dazomet (Tetrahydro-3,5-dimethyl-2H-1,3,5-thiadiazine-2-thione)	1.0	X		
53404-60-7	Dazomet, sodium salt (Tetrahydro-3,5-dimethyl-2H-1,3,5-thiadiazine-2-thione, ion(1-), sodium)	1.0			
1163-19-5	Decabromodiphenyl oxide	1.0			
13684-56-5	Desmedipham	1.0			
117-81-7	Di(2-ethylhexyl) phthalate (DEHP)	0.1	X	X	U028
2303-16-4	Diallate [Carbamothioic acid, bis(1-methylethyl)-S-(2,3-dichloro-2-propenyl)ester]	1.0	X		U062
25376-45-8	Diaminotoluene (mixed isomers)	0.1	X		U221
333-41-5	Diazinon	1.0			
334-88-3	Diazomethane	1.0			
226-36-8	Dibenz(a,h)acridine				
224-42-0	Dibenz(a,j)acridine				

5385-75-1	Dibenzo(a,e)fluoranthene	1.0			
192-65-4	Dibenzo(a,e)pyrene				
53-70-3	Dibenzo(a,h)anthracene				U063
189-64-0	Dibenzo(a,h)pyrene				
191-30-0	Dibenzo(a,l)pyrene				
132-64-9	Dibenzofuran	1.0			
124-73-2	Dibromotetrafluoroethane (Halon 2402)	1.0			
84-74-2	Dibutyl phthalate	1.0	X	X	U069
1918-00-9	Dicamba (3,6-Dichloro-2-methyoxybenzoic acid)	1.0			
99-30-9	Dichloran (2,6-Dichloro-4-nitroaniline)	1.0			
90454-18-5	Dichloro-1,1,2-trifluoroethane	1.0			
25321-22-6	Dichlorobenzene (mixed isomers)	0.1	X		
75-27-4	Dichlorobromomethane	1.0		X	
75-71-8	Dichlorodifluoromethane (CFC-12)	1.0	X	X	U075
75-43-4	Dichlorofluoromethane (HCFC-21)	1.0			
75-09-2	Dichloromethane (Methylene chloride)	0.1	X	X	U080
127564-92-5	Dichloropentafluoropropane	1.0			
97-23-4	Dichlorophene (2,2'-Methylenebis(4-chlorophenol)	1.0			
76-14-2	Dichlorotetrafluoroethane (CFC-114)	1.0			
34077-87-7	Dichlorotrifluoroethane	1.0			
62-73-7	Dichlorvos [Phosphoric acid, 2-dichloroethenyl dimethyl ester]	0.1			
51338-27-3	Diclofop methyl (2-[4-(2,4-Dichlorophenoxy) phenoxy]propanoic acid, methyl ester)	1.0			
115-32-2	Dicofol [Benzenemethanol, 4-chloro-.alpha.-4-chlorophenyl)-.alpha.-(trichloromethyl)-]	1.0			
77-73-6	Dicyclopentadiene	1.0			
1464-53-5	Diepoxybutane	0.1	X		U085
111-42-2	Diethanolamine	1.0			
38727-55-8	Diethatyl ethyl	1.0			
84-66-2	Diethyl phthalate	0.1			U088
64-67-5	Diethyl sulfate	0.1			
134190-37-7	Diethyldiisocyanatobenzene				
35367-38-5	Diflubenzuron	1.0			
101-90-6	Diglycidyl resorcinol ether	0.1			
94-58-6	Dihydrosafrole	0.1	X		U090
55290-64-7	Dimethipin (2,3,-Dihydro-5,6-dimethyl-1,4-dithiin 1,1,4,4-tetraoxide)	1.0			
60-51-5	Dimethoate	1.0	X		P044
2524-03-0	Dimethyl chlorothiophosphate	1.0			
131-11-3	Dimethyl phthalate	1.0	X	X	U102
77-78-1	Dimethyl sulfate	0.1	X		U103
124-40-3	Dimethylamine	1.0			U092
2300-66-5	Dimethylamine dicamba	1.0			
79-44-7	Dimethylcarbamyl chloride	0.1	X		U097
88-85-7	Dinitrobutyl phenol (Dinoseb)	1.0			P020
25321-14-6	Dinitrotoluene (mixed isomers)	1.0			
39300-45-3	Dinocap	1.0			
957-51-7	Diphenamid	1.0			
122-39-4	Diphenylamine	1.0	X		
2164-07-0	Dipotassium endothall (7-Oxabicyclo(2.2.1)heptane-2,3-dicarboxylic acid, dipotassium salt)	1.0			
136-45-8	Dipropyl isocinchomeronate	1.0			
138-93-2	Disodium cyanodithioimidocarbonate	1.0			

330-54-1	Diuron	1.0			
2439-10-3	Dodine (Dodecylguanidine monoacetate)	1.0			
106-89-8	Epichlorohydrin	0.1	X		U041
13194-48-4	Ethoprop (Phosphorodithioic acid O-ethyl S,S-dipropyl ester)	1.0			
140-88-5	Ethyl acrylate	0.1			U113
541-41-3	Ethyl chloroformate	1.0			
759-94-4	Ethyl dipropylthiocarbamate (EPTC)	1.0	X	X	
100-41-4	Ethylbenzene	1.0		X	
74-85-1	Ethylene	1.0			
107-21-1	Ethylene glycol	1.0			
75-21-8	Ethylene oxide	0.1	X	X	U115
96-45-7	Ethylene thiourea	0.1	X		U116
151-56-4	Ethyleneimine (Aziridine)	0.1	X		P054
75-34-3	Ethylidene dichloride	1.0	X	X	U076
52-85-7	Famphur	1.0	X	X	P097
60168-88-9	Fenarimol (.alpha.-(2-Chlorophenyl)-.alpha.-4-chlorophenyl)-5-pyrimidinemethanol)	1.0			
13356-08-6	Fenbutatin oxide (Hexakis(2-methyl-2-phenylpropyl)distannoxane)	1.0			
66441-23-4	Fenoxaprop ethyl (2-(4-((6-Chloro-2-benzoxazolylen)oxy)phenoxy)propanoic acid, ethyl ester)	1.0			
72490-01-8	Fenoxycarb (2-(4-Phenoxy-phenoxy)-ethyl]carbamic acid ethyl ester)	1.0			
39515-41-8	Fenpropathrin (2,2,3,3-Tetramethylcyclopropane carboxylic acid cyano(3-phenoxyphenyl)methyl ester)	1.0			
55-38-9	Fenthion (O,O-Dimethyl O-[3-methyl-4-(methylthio) phenyl] ester, phosphorothioic acid)	1.0			
51630-58-1	Fenvalerate (4-Chloro-alpha-(1-methylethyl)benzeneacetic acid cyano(3-phenoxyphenyl)methyl ester)	1.0			
14484-64-1	Ferbam (Tris(dimethylcarbamodithioato-S,S')iron)	1.0	X		
69806-50-4	Fluazifop butyl (2-[4-[[5-(Trifluoromethyl)-2-pyridinyl]oxy]-phenoxy]propanoic acid, butyl ester)	1.0			
2164-17-2	Fluometuron [Urea, N,N-dimethyl-N'-[3-(trifluoromethyl)phenyl]-]	1.0			
7782-41-4	Fluorine	1.0	X		P056
51-21-8	Fluorouracil (5-Fluorouracil)	1.0			
69409-94-5	Fluvalinate (N-[2-Chloro-4-(trifluoromethyl)phenyl]-DL-valine(+)-cyano(3-phenoxyphenyl)methyl ester)	1.0			
133-07-3	Folpet	1.0			
72178-02-0	Fomesafen (5-(2-Chloro-4-(trifluoromethyl)phenoxy)-N methylsulfonyl)-2-nitrobenzamide)	1.0			
50-00-0	Formaldehyde	0.1	X		U122
64-18-6	Formic acid	1.0	X		U123
76-13-1	Freon 113 [Ethane, 1,1,2-trichloro-1,2,2,-trifluoro-]	1.0		X	
76-44-8	Heptachlor [1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methano-1H-indene]		X	X	P059
87-68-3	Hexachloro-1,3-butadiene	1.0	X	X	U128
118-74-1	Hexachlorobenzene	0.1	X	X	U127
77-47-4	Hexachlorocyclopentadiene	1.0	X	X	U130
67-72-1	Hexachloroethane	1.0	X	X	U131
1335-87-1	Hexachloronaphthalene	1.0			
70-30-4	Hexachlorophene	1.0	X		U132
680-31-9	Hexamethylphosphoramide	0.1			

51235-04-2	Hexazinone	1.0			
67485-29-4	Hydramethylnon (Tetrahydro-5,5-dimethyl-2(1H)-pyrimidinone[3-[4-(trifluoromethyl)phenyl]-1-[2-[4-(trifluoromethyl)phenyl]ethenyl]-2-propenylidene]hydrazone)	1.0			
302-01-2	Hydrazine	0.1	X		U133
10034-93-2	Hydrazine sulfate	0.1			
7647-01-0	Hydrochloric acid	1.0			
74-90-8	Hydrogen cyanide	1.0	X		P063
7664-39-3	Hydrogen fluoride	1.0	X		U134
123-31-9	Hydroquinone	1.0			
35554-44-0	Imazalil (1-[2-(2,4-Dichlorophenyl)-2-(2-propenyloxy)ethyl]-1H-imidazole)	1.0			
193-39-5	Indeno[1,2,3-cd]pyrene				U137
13463-40-6	Iron pentacarbonyl	1.0			
78-84-2	Isobutyraldehyde	1.0			
465-73-6	Isodrin	1.0	X	X	P060
25311-71-1	Isofenphos (2-[[Ethoxyl[(1-methylethyl)amino] phosphinothioyl]oxy] benzoic acid 1-methylethyl ester)	1.0			
4098-71-9	Isophorone diisocyanate	1.0			
67-63-0	Isopropyl alcohol (mfg-strong acid process)	1.0			
120-58-1	Isosafrole	1.0	X	X	U141
77501-63-4	Lactofen (5-(2-Chloro-4-(trifluoromethyl)phenoxy)-2-nitro-2-ethoxy-1-methyl-2-oxoethyl ester)	1.0			
7439-92-1	Lead	0.1	X	X	
58-89-9	Lindane [Cyclohexane, 1,2,3,4,5,6-hexachloro-,(1.alpha.,2.alpha.,3.beta.,4.alpha.,5.alpha.,6.beta.)-]	0.1	X	X	U129
330-55-2	Linuron	1.0			
554-13-2	Lithium carbonate	1.0			
108-39-4	m-Cresol	1.0		X*	U052
99-65-0	m-Dinitrobenzene	1.0			
108-38-3	m-Xylene	1.0		X*	U239
121-75-5	Malathion	1.0			
108-31-6	Maleic anhydride	1.0	X		U147
109-77-3	Malononitrile	1.0	X		U149
12427-38-2	Maneb [Carbamodithioic acid, 1,2-ethanediylbis-, manganese complex]	1.0			
7439-96-5	Manganese	1.0			
93-65-2	Mecoprop	0.1			
7439-97-6	Mercury	1.0	X	X	U151
150-50-5	Merphos	1.0			
126-98-7	Methacrylonitrile	1.0	X	X	
137-42-8	Metham sodium (Sodium methyldithiocarbamate)	1.0	X		
67-56-1	Methanol	1.0		X	U154
20354-26-1	Methazole (2-(3,4-Dichlorophenyl)-4-methyl-1,2,4-oxadiazolidine-3,5-dione)	1.0			
2032-65-7	Methiocarb	1.0	X	X	
94-74-6	Methoxone ((4-Chloro-2-methylphenoxy) acetic acid) (MCPA)	0.1			
3653-48-3	Methoxone sodium salt ((4-Chloro-2-methylphenoxy) acetate sodium salt)	0.1			
72-43-5	Methoxychlor [Benzene, 1,1'-(2,2,2-trichloroethylidene)bis [4-methoxy-]	1.0	X	X	U247
96-33-3	Methyl acrylate	1.0			

79-22-1	Methyl chlorocarbonate	1.0	X		U156
78-93-3	Methyl ethyl ketone	1.0	X	X	U159
60-34-4	Methyl hydrazine	1.0	X		P068
74-88-4	Methyl iodide	1.0	X	X	U138
108-10-1	Methyl isobutyl ketone	1.0		X	U161
624-83-9	Methyl isocyanate	1.0	X		P064
556-61-6	Methyl isothiocyanate (Isothiocyanatomethane)	1.0			
80-62-6	Methyl methacrylate	1.0	X	X	U162
298-00-0	Methyl parathion	1.0	X	X	P071
1634-04-4	Methyl tert-butyl ether	1.0			
74-95-3	Methylene bromide	1.0	X	X	U068
101-68-8	Methylenebis(phenylisocyanate) (MBI)				
101-68-8	Methylenebis(phenylisocyanate) (MDI)				
9006-42-2	Metiram	1.0			
21087-64-5	Metribuzin	1.0			
7786-34-7	Mevinphos	1.0			
90-94-8	Michler's ketone	0.1			
2212-67-1	Molinate (1H-Azepine-1 carbothioic acid, hexahydro-S-ethyl ester)	1.0	X	X	
1313-27-5	Molybdenum trioxide	1.0			
76-15-3	Monochloropentafluoroethane (CFC-115)	1.0			
150-68-5	Monuron	1.0			
505-60-2	Mustard gas [Ethane, 1,1'-thiobis[2-chloro-]	0.1	X		
88671-89-0	Myclobutanil (.alpha.-Butyl-.alpha.-(4-chlorophenyl)-1H-1,2,4-triazole-1-propanenitrile)	1.0			
121-69-7	N,N-Dimethylaniline	1.0			
68-12-2	N,N-Dimethylformamide	0.1			
71-36-3	n-Butyl alcohol	1.0		X	U031
110-54-3	n-Hexane	1.0			
872-50-4	N-Methyl-2-pyrrolidone	1.0			
924-42-5	N-Methylolacrylamide	1.0			
759-73-9	N-Nitroso-N-ethylurea	0.1	X		U176
684-93-5	N-Nitroso-N-methylurea	0.1	X		U177
924-16-3	N-Nitrosodi-n-butylamine	0.1	X	X	U172
621-64-7	N-Nitrosodi-n-propylamine	0.1	X	X	U111
55-18-5	N-Nitrosodiethylamine	0.1	X	X	U174
62-75-9	N-Nitrosodimethylamine	0.1	X		P082
86-30-6	N-Nitrosodiphenylamine	1.0		X	
4549-40-0	N-Nitrosomethylvinylamine	0.1	X		P084
59-89-2	N-Nitrosomorpholine	0.1	X	X	
16543-55-8	N-Nitrosonornicotine	0.1	X		
100-75-4	N-Nitrosopiperidine	0.1	X	X	U179
142-59-6	Nabam	1.0			
300-76-5	Naled	1.0			
91-20-3	Naphthalene	1.0	X	X	U165
7440-02-0	Nickel	0.1	X	X	
1929-82-4	Nitrapyrin (2-Chloro-6-(trichloromethyl)pyridine)	1.0			
7697-37-2	Nitric acid	1.0			
139-13-9	Nitrilotriacetic acid	0.1			
98-95-3	Nitrobenzene	1.0	X	X	U169
1836-75-5	Nitrofen [Benzene, 2,4-dichloro-1-(4-nitrophenoxy)-]	0.1			
51-75-2	Nitrogen mustard [2-Chloro-N-(2-chloroethyl)-N-methylethanamine]	0.1	X		
55-63-0	Nitroglycerin	1.0	X		P081

27314-13-2	Norflurazon (4-Chloro-5-(methylamino)-2-[3-(trifluoromethyl)phenyl]-3(2H)-pyridazinone)	1.0			
90-04-0	o-Anisidine	0.1			
134-29-2	o-Anisidine hydrochloride	0.1			
95-48-7	o-Cresol	1.0		X	U052
528-29-0	o-Dinitrobenzene	1.0			
95-53-4	o-Toluidine	0.1	X		U328
636-21-5	o-Toluidine hydrochloride	0.1	X		U222
95-47-6	o-Xylene	1.0		X	U239
2234-13-1	Octachloronaphthalene	1.0			
19044-88-3	Oryzalin (4-(Dipropylamino)-3,5-dinitrobenzenesulfonamide)	1.0			
20816-12-0	Osmium tetroxide	1.0	X		P087
301-12-2	Oxydemeton methyl (S-(2-(Ethylsulfinyl)ethyl) O,O-dimethyl ester phosphorothioic acid)	1.0			
19666-30-9	Oxydiazon (3-[2,4-Dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2(3H)-one)	1.0			
42874-03-3	Oxyfluorfen	1.0			
10028-15-6	Ozone	1.0			
104-94-9	p-Anisidine	1.0			
95-69-2	p-Chloro-o-toluidine	0.1			
106-47-8	p-Chloroaniline	0.1	X	X	P024
104-12-1	p-Chlorophenyl isocyanate	1.0			
120-71-8	p-Cresidine	0.1			
106-44-5	p-Cresol	1.0		X*	U239
100-25-4	p-Dinitrobenzene	1.0		X	
100-01-6	p-Nitroaniline	1.0	X	X	P077
156-10-5	p-Nitrosodiphenylamine	1.0			
106-50-3	p-Phenylenediamine	1.0			
106-42-3	p-Xylene	1.0		X*	U239
123-63-7	Paraldehyde	1.0	X		U182
1910-42-5	Paraquat dichloride	1.0			
56-38-2	Parathion [Phosphorothioic acid, O,O-diethyl-O-(4-nitrophenyl) ester]	1.0	X	X	P089
1114-71-2	Pebulate (Butylethylcarbamothioic acid S-propyl ester)	1.0	X	X	
40487-42-1	Pendimethalin (N-(1-Ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine)	1.0			
76-01-7	Pentachloroethane	1.0	X	X	U184
87-86-5	Pentachlorophenol (PCP)	0.1	X	X	
57-33-0	Pentobarbital sodium	1.0			
79-21-0	Peracetic acid	1.0			
594-42-3	Perchloromethyl mercaptan	1.0			
52645-53-1	Permethrin (3-(2,2-Dichloroethenyl)-2,2-dimethylcyclopropane carboxylic acid, (3-phenoxyphenyl)methyl ester)	1.0			
85-01-8	Phenanthrene	1.0		X	
108-95-2	Phenol	1.0	X		U188
26002-80-2	Phenothrin (2,2-Dimethyl-3-(2-methyl-1-propenyl)cyclopropanecarboxylic acid (3-phenoxyphenyl)methyl ester)	1.0			
57-41-0	Phenytoin	0.1			
75-44-5	Phosgene	1.0	X		P095
7803-51-2	Phosphine	1.0	X		P096
7664-38-2	Phosphoric acid	1.0			

7723-14-0	Phosphorus (yellow or white)	1.0			
85-44-9	Phthalic anhydride	1.0	X	X	U190
1918-02-1	Picloram	1.0			
88-89-1	Picric acid	1.0			
51-03-6	Piperonyl butoxide	1.0			
29232-93-7	Pirimiphos methyl (O-(2-(Diethylamino)-6-methyl-4-pyrimidinyl)-O,O-dimethyl phosphorothioate)	1.0			
1336-36-3	Polychlorinated biphenyls (PCBs)	0.1		X	
9016-87-9	Polymeric diphenylmethane diisocyanate	1.0			
7758-01-2	Potassium bromate	0.1			
128-03-0	Potassium dimethyldithiocarbamate	1.0	X		
137-41-7	Potassium N-methyldithiocarbamate	1.0	X		
41198-08-7	Profenofos (O-(4-Bromo-2-chlorophenyl)-O-ethyl-S-propylphosphorothioate)	1.0			
7287-19-6	Prometryn (N,N'-Bis(1-methylethyl)-6-methylthio-1,3,5-triazine-2,4-diamine)	1.0			
23950-58-5	Pronamide	1.0	X	X	U192
1918-16-7	Propachlor (2-Chloro-N-(1-methylethyl)-N-phenylacetamide)	1.0			
1120-71-4	Propane sultone	0.1	X		U193
709-98-8	Propanil (N-(3,4-Dichlorophenyl)propanamide)	1.0			
2312-35-8	Propargite	1.0			
107-19-7	Propargyl alcohol	1.0	X		P102
31218-83-4	Propetamphos (3-[(Ethylamino)methoxyphosphinothioyl]oxy]-2-butenoic acid, 1-methylethyl ester)	1.0			
60207-90-1	Propiconazole (1-[2-(2,4-Dichlorophenyl)-4-propyl-1,3-dioxolan-2-yl]-methyl-1H-1,2,4,-triazole)	1.0			
123-38-6	Propionaldehyde	1.0			
114-26-1	Propoxur [Phenol, 2-(1-methylethoxy)-, methylcarbamate]	1.0	X	X	
115-07-1	Propylene (Propene)	1.0			
75-56-9	Propylene oxide	0.1			
75-55-8	Propyleneimine	0.1	X		P067
110-86-1	Pyridine	1.0	X	X	U196
91-22-5	Quinoline	1.0			
106-51-4	Quinone	1.0	X		U197
82-68-8	Quintozene (Pentachloronitrobenzene)	1.0	X	X	U185
76578-14-8	Quizalofop-ethyl (2-[4-[(6-Chloro-2-quinoxalinyl)oxy]phenoxy] propanoic acid ethyl ester)	1.0			
10453-86-8	Resmethrin ([5-(Phenylmethyl)-3-furanyl]methyl 2,2-dimethyl-3-(2-methyl-1-propenyl)cyclopropanecarboxylate])	1.0			
78-48-8	S,S,S-Tributyltrithiophosphate (DEF)	1.0			
81-07-2	Saccharin (manufacturing)	0.1	X		U202
94-59-7	Safrole	0.1	X	X	U203
78-92-2	sec-Butyl alcohol	1.0			
7782-49-2	Selenium	1.0	X	X	
74051-80-2	Sethoxydim (2-[1-(Ethoxyimino) butyl]-5-[2-(ethylthio)propyl]-3-hydroxyl-2-cyclohexen-1-one)	1.0			
7440-22-4	Silver	1.0	X	X	
122-34-9	Simazine	1.0			
26628-22-8	Sodium azide	1.0			P105
1982-69-0	Sodium dicamba (3,6-Dichloro-2-methoxybenzoic acid, sodium salt)	1.0			

128-04-1	Sodium dimethyldithiocarbamate	1.0	X		
62-74-8	Sodium fluoroacetate	1.0	X		P058
7632-00-0	Sodium nitrite	1.0			
132-27-4	Sodium o-phenylphenoxide	0.1			
131-52-2	Sodium pentachlorophenate	1.0			
100-42-5	Styrene	0.1			
96-09-3	Styrene oxide	0.1			
7664-93-9	Sulfuric acid	1.0			
2699-79-8	Sulfuryl fluoride (Vikane)	1.0			
35400-43-2	Sulprofos (O-Ethyl O-[4-(methylthio)phenyl]phosphorodithioic acid S-propyl ester)	1.0			
34014-18-1	Tebuthiuron (N-[5-(1,1-Dimethylethyl)-1,3,4-thiadiazol-2-yl)-N,N'-dimethylurea)	1.0			
3383-96-8	Temephos	1.0			
5902-51-2	Terbacil (5-Chloro-3-(1,1-dimethylethyl)-6-methyl- 2,4 (1H,3H)-pyrimidinedione)	1.0			
75-65-0	tert-Butyl alcohol	1.0			
127-18-4	Tetrachloroethylene (Perchloroethylene)	0.1	X	X	
961-11-5	Tetrachlorvinphos [Phosphoric acid, 2-chloro-1-(2,3,5-trichlorophenyl) ethenyl dimethyl ester]	1.0			
64-75-5	Tetracycline hydrochloride	1.0			
7696-12-0	Tetramethrin (2,2-Dimethyl-3-(2-methyl-1-propenyl)cyclopropanecarboxylic acid (1,3,4,5,6,7-hexahydro-1,3-dioxo-2H-isoindol-2-yl)methyl ester)	1.0			
7440-28-0	Thallium	1.0	X	X	
148-79-8	Thiabendazole (2-(4-Thiazolyl)-1H-benzimidazole)	1.0			
62-55-5	Thioacetamide	0.1	X		U218
28249-77-6	Thiobencarb (Carbamic acid, diethylthio-, S-(p-chlorobenzyl))	1.0			
59669-26-0	Thiodicarb	1.0	X	X	
23564-05-8	Thiophanate-methyl	1.0	X	X	
23564-06-9	Thiophanate ethyl ([1,2-Phenylenebis (iminocarbonothioyl)] biscarbamic acid diethyl ester)	1.0			
79-19-6	Thiosemicarbazide	1.0	X		P116
62-56-6	Thiourea	0.1	X		U219
137-26-8	Thiram	1.0	X		U244
1314-20-1	Thorium dioxide	1.0			
7550-45-0	Titanium tetrachloride	1.0			
108-88-3	Toluene	1.0	X	X	U220
584-84-9	Toluene-2,4-diisocyanate	0.1			
91-08-7	Toluene-2,6-diisocyanate	0.1			
26471-62-5	Toluene diisocyanate (mixed isomers)	0.1	X		U223
8001-35-2	Toxaphene	0.1	X	X	P123
10061-02-6	trans-1,3-Dichloropropene	0.1		X	
110-57-6	trans-1,4-Dichloro-2-butene	1.0			
43121-43-3	Triadimefon (1-(4-Chlorophenoxy)-3,3-dimethyl-1-(1H-1,2,4-triazol-1-yl)-2-butanone)	1.0			
2303-17-5	Triallate	1.0	X	X	
68-76-8	Triaziquone [2,5-Cyclohexadiene-1,4-dione, 2,3,5-tris(1-aziridinyl)-]	1.0			
101200-48-0	Tribenuron methyl (2-(4-Methoxy-6-methyl-1,3,5-triazin-2-yl)-methylamino)carbonyl)amino)sulfonyl)-, methyl ester)	1.0			
1983-10-4	Tributyltin fluoride	1.0			
2155-70-6	Tributyltin methacrylate	1.0			

52-68-6	Trichlorfon [Phosphonic acid, (2,2,2-trichloro-1-hydroxyethyl)-,dimethyl ester]	1.0			
76-02-8	Trichloroacetyl chloride	1.0			
79-01-6	Trichloroethylene	0.1	X	X	U228
75-69-4	Trichlorofluoromethane (CFC-11)	1.0	X	X	U121
57213-69-1	Triclopyr triethylammonium salt	1.0			
121-44-8	Triethylamine	1.0	X		
1582-09-8	Trifluralin [Benezeneamine, 2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)-]	1.0			
26644-46-2	Triforine (N,N'-[1,4-Piperazinediylbis(2,2,2-trichloroethylidene)] bisformamide)	1.0			
639-58-7	Triphenyltin chloride	1.0			
76-87-9	Triphenyltin hydroxide	1.0			
126-72-7	Tris(2,3-dibromopropyl) phosphate	0.1	X	X	U235
72-57-1	Trypan blue	0.1	X		U236
51-79-6	Urethane (Ethyl carbamate)	0.1	X		U238
7440-62-2	Vanadium (fume or dust)	1.0		X	
50471-44-8	Vinclozolin (3-(3,5-Dichlorophenyl)-5-ethenyl-5-methyl-2,4-oxazolidinedione)	1.0			
108-05-4	Vinyl acetate	0.1			
593-60-2	Vinyl bromide	0.1			
75-01-4	Vinyl chloride	0.1	X	X	U043
75-35-4	Vinylidene chloride	1.0	X	X	U078
1330-20-7	Xylene (mixed isomers)	1.0		X	U239
7440-66-6	Zinc (fume or dust)	1.0		X	
12122-67-7	Zineb [Carbamodithioic acid, 1,2-ethanediylbis-, zinc complex]	1.0			

* as mixed isomers (sum)

Chemical Categories

Section 313 requires reporting on the toxic chemical categories listed below, in addition to the specific toxic chemicals listed above.

The metal compounds listed below, unless otherwise specified, are defined as including any unique chemical substance that contains the named metal (i.e., antimony, nickel, etc.) as part of that chemical's structure.

Toxic chemical categories are subject to the 1 percent *de minimis* concentration unless the substance involved meets the definition of an OSHA carcinogen in which case the 0.1

percent *de minimis* concentration applies. The *de minimis* concentration for each category is provided in parentheses.

Chemical Categories

Antimony Compounds (1.0)

Includes any unique chemical substance that contains antimony as part of that chemical's infrastructure.

Arsenic Compounds (inorganic compounds: 0.1; organic compounds: 1.0)

Includes any unique chemical substance that contains arsenic as part of that chemical's infrastructure.

Barium Compounds (1.0)

Includes any unique chemical substance that contains barium as part of that chemical's infrastructure.

This category does not include: Barium sulfate CAS Number 7727-43-7

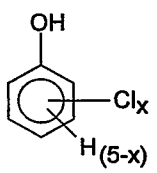
Beryllium Compounds (0.1)

Includes any unique chemical substance that contains beryllium as part of that chemical's infrastructure.

Cadmium Compounds (0.1)

Includes any unique chemical substance that contains cadmium as part of that chemical's infrastructure.

Chlorophenols (0.1)



Where x = 1 to 5

Chromium Compounds (chromium VI compounds: 0.1; chromium III compounds: 1.0)

Includes any unique chemical substance that contains chromium as part of that chemical's infrastructure.

Cobalt Compounds (0.1)

Includes any unique chemical substance that contains cobalt as part of that chemical's infrastructure.

Copper Compounds (1.0)

Includes any unique chemical substance that contains copper as part of that chemical's infrastructure.

This category does not include copper phthalocyanine compounds that are substituted with only hydrogen, and/or chlorine, and/or bromine.

Cyanide Compounds (1.0)

X^+CN^- where $X = H^+$ or any other group where a formal dissociation may occur. For example KCN or $Ca(CN)_2$.

Diisocyanates (1.0)

This category includes only those chemicals listed below.

38661-72-2	1,3-Bis(methylisocyanate)cyclohexane
10347-54-3	1,4-Bis(methylisocyanate)cyclohexane
2556-36-7	1,4-Cyclohexane diisocyanate
134190-37-7	Diethyldiisocyanatobenzene
4128-73-8	4,4'-Diisocyanatodiphenyl ether
75790-87-3	2,4'-Diisocyanatodiphenyl sulfide
91-93-0	3,3'-Dimethoxybenzidine-4,4'-diisocyanate
91-97-4	3,3'-Dimethyl-4,4'-diphenylene diisocyanate
139-25-3	3,3'-Dimethyldiphenylmethane-4,4'-diisocyanate
822-06-0	Hexamethylene-1,6-diisocyanate
4098-71-9	Isophorone diisocyanate
75790-84-0	4-Methyldiphenylmethane-3,4-diisocyanate
5124-30-1	1,1-Methylene bis(4-isocyanatocyclohexane)
101-68-8	Methylenebis(phenylisocyanate) (MDI)
3173-72-6	1,5-Naphthalene diisocyanate
123-61-5	1,3-Phenylene diisocyanate
104-49-4	1,4-Phenylene diisocyanate
9016-87-9	Polymeric diphenylmethane diisocyanate
16938-22-0	2,2,4-Trimethylhexamethylene diisocyanate

15646-96-5 2,4,4-Trimethylhexamethylene diisocyanate

Ethylenebisdithiocarbamic acid, salts and esters (EBDCs) (1.0)

Includes any unique chemical substance that is or that contains EBDC or an EBDC salt or ester as part of that chemical's infrastructure.

Certain Glycol Ethers (1.0)

$R-(OCH_2CH_2)_n-OR'$

Where n = 1, 2, or 3

R = alkyl C7 or less; or

R = phenyl or alkyl substituted phenyl;

R' = H, or alkyl C7 or less; or

OR' consisting of carboxylic acid ester, sulfate, phosphate, nitrate, or sulfonate.

Lead Compounds (inorganic compounds: 0.1; organic compounds 1.0)

Includes any unique chemical substance that contains lead as part of that chemical's infrastructure.

Manganese Compounds (1.0)

Includes any unique chemical substance that contains manganese as part of that chemical's infrastructure.

Mercury Compounds (1.0)

Includes any unique chemical substance that contains mercury as part of that chemical's infrastructure.

Nickel Compounds (0.1)

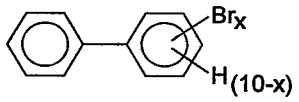
Includes any unique chemical substance that contains nickel as part of that chemical's infrastructure.

Nicotine and salts (1.0)

Includes any unique chemical substance that contains nicotine or a nicotine salt as part of that chemical's infrastructure.

Nitrate compounds (water dissociable; reportable only when in aqueous solution) (1.0)

Polybrominated Biphenyls (PBBs) (0.1)



Where x = 1 to 10

Polychlorinated alkanes (C10 to C13) (1.0, except for those members of the category that have an average chain length of 12 carbons and contain an average chlorine content of 60 percent by weight which are subject to the 0.1 percent *de minimis*)

$C_xH_{2x+2-y}Cl_y$

where x = 10 to 13;

y = 3 to 12; and

the average chlorine content ranges from 40 - 70% with the limiting molecular formulas $C_{10}H_{19}Cl_3$ and $C_{13}H_{16}Cl_{12}$.

Polycyclic aromatic compounds (PACs) (0.1, except for benzo(a)phenanthrene and dibenzo(a,e)fluoranthene which are subject to the 1.0 percent *de minimis*)

This category includes only those chemicals listed below.

56-55-3	Benz(a)anthracene
205-99-2	Benzo(b)fluoranthene
205-82-3	Benzo(j)fluoranthene
207-08-9	Benzo(k)fluoranthene
189-55-9	Benzo(rst)pentaphene
218-01-9	Benzo(a)phenanthrene
50-32-8	Benzo(a)pyrene
226-36-8	Dibenz(a,h)acridine
224-42-0	Dibenz(a,j)acridine
53-70-3	Dibenzo(a,h)anthracene
194-59-2	7H-Dibenzo(c,g)carbazole
5385-75-1	Dibenzo(a,e)fluoranthene
192-65-4	Dibenzo(a,e)pyrene

189-64-0 Dibenzo(a,h)pyrene
191-30-0 Dibenzo(a,l)pyrene
57-97-6 7,12-Dimethylbenz(a)anthracene
193-39-5 Indeno[1,2,3-cd]pyrene
3697-24-3 5-Methylchrysene
5522-43-0 1-Nitropyrene

Selenium Compounds (1.0)

Includes any unique chemical substance that contains selenium part of that chemical's infrastructure.

Silver Compounds (1.0)

Includes any unique chemical substance that contains silver part of that chemical's infrastructure.

Strychnine and salts (1.0)

Includes any unique chemical substance that contains strychnine or a strychnine salt as part of that chemical's infrastructure.

Thallium Compounds (1.0)

Includes any unique chemical substance that contains thallium as part of that chemical's infrastructure.

Warfarin and salts (1.0)

Includes any unique chemical substance that contains warfarin or a warfarin salt as part of that chemical's infrastructure.

Zinc Compounds (1.0)

Includes any unique chemical substance that contains zinc as part of that chemical's infrastructure.

APPENDIX B
LIST OF ACTIVITIES THAT FALL UNDER EACH SIC CODE IN MAJOR GROUP 10

Major group 10, metal mining, includes establishments primarily engaged in mining, developing mines, or exploring for metallic minerals (ores). These ores are valued chiefly for the metals contained, to be recovered for use as such, or as constituents of alloys, chemicals, pigments, or other products. This major group also includes all ore dressing and beneficiating operations, whether performed at mills in conjunction with mines, or at mills, such as custom mills, operated separately from the mines served. These include mills that crush, grind, wash, dry, sinter, calcine, or leach ore, or perform gravity separation or flotation operations (U.S. OMB, 1987).

When performed by operators of the properties, exploration under preliminary phases of operation should be classified according to the type of ore expected to be found. Exploration performed on a contract or fee basis is classified in Industry 1081 (U.S. OMB, 1987).

1011	Iron ores:	Establishments primarily engaged in mining, beneficiating, or otherwise preparing iron ores and manganiferous ores valued chiefly for their iron content. This industry includes production of sinter and other agglomerates except those associated with blast furnace operations. Blast furnaces primarily engaged in producing pig iron from iron ore are classified in Manufacturing Industry 3312. **Not a covered facility as defined under 40 CFR 372.22.**
1021	Copper ores:	Establishments primarily engaged in mining, milling, or otherwise preparing copper ores. This industry also includes establishments primarily engaged in the recovery of copper concentrates by precipitation and leaching of copper ore. Establishments primarily engaged in the recovery of refined copper by leaching copper concentrates are classified in Manufacturing, Major Group 33.
1031	Lead and zinc ores:	Establishments primarily engaged in mining, milling, or otherwise preparing lead ores, zinc ores, or lead-zinc ores.

1041	Gold ores:	Establishments primarily engaged in mining gold ores from lode[3] deposits or in the recovery of gold from placer deposits by any method. In addition to ore dressing methods such as crushing, grinding, gravity concentration, and froth flotation, this industry includes amalgamation, cyanidation, and the production of bullion at the mine, mill, or dredge site.
1044	Silver ores:	Establishments primarily engaged in mining, milling, or otherwise preparing silver ores. The production of bullion at the mine or mill site is included.
1061	Ferroalloy ores, except vanadium:	Establishments primarily engaged in mining, milling, or otherwise preparing ferroalloy ores, except vanadium. The mining of manganiferous ores chiefly valued for their iron content is classified in Industry 1011. Establishments primarily engaged in mining vanadium ore are classified in Industry 1094, and those mining titanium ore are classified in Industry 1099.
1081	Metal mining services:	Establishments primarily engaged in performing metal mining services for others on a contract or fee basis, such as the removal of overburden, strip mining for metallic ores, prospect and test drilling, and mine exploration and development. Establishments which have complete responsibility for operating mines for others on a contract or fee basis are classified according to the product mined rather than as metal mining services. Establishments primarily performing hauling services are classified in Division E, Transportation. **Not a covered facility as defined under 40 CFR 372.22.**
1094	Uranium-radium-vanadium ores:	Establishments primarily engaged in mining, milling, or otherwise preparing uranium-radium-vanadium ores. **Not a covered facility as defined under 40 CFR 372.22.**
1099	Miscellaneous	Establishments primarily engaged in mining, milling, or otherwise

[3]A lode is defined as a vein of metal ore.

metal ores, not	preparing miscellaneous metal ores, not elsewhere classified.
elsewhere	Production of metallic mercury by furnacing or retorting at the mine
classified:	site is also included.

APPENDIX C
BIBLIOGRAPHY

Encyclopedia of Chemical Technology. Kirk Othmer, 4th Ed., Vol 10 and 16, John Wiley & Sons, Inc. New York, NY. 1995.

United States Department of the Interior, Bureau of Mines. *Minerals Yearbook,* Volume 1, 1992.

U.S. Environmental Protection Agency, Office of Solid Waste. *Technical Resource Document: Extraction and Beneficiation of Ores and Minerals, Volume 4, Copper.* EPA 530-R-94-031. 1994.

U.S. Environmental Protection Agency. Office of Solid Waste. *Technical Resource Document: Extraction and Beneficiation of Ores and Minerals. Volume 2. Gold,* EPA 530-R-94-013. 1994.

U.S. Environmental Protection Agency. Office of Solid Waste, Special Waste Branch. *Technical Report: Design and Evaluation of Tailings Dams.* EPA 530-R-94-038. August, 1994.

U.S. Environmental Protection Agency. Office of Solid Waste. *Technical Background Document: Identification and Description of Mineral Processing Sectors and Waste Streams.* 1996.

U.S. Environmental Protection Agency. *Economic Analysis of the Final Rule to Add Certain Industry Groups to EPCRA Section 313,* Appendix H.

U.S. OMB. Standard Industrial Classification Code Manual, 1987

APPENDIX D
SECTION 313 RELATED MATERIALS AND ELECTRONIC ACCESS TO INFORMATION

Ordering information for the following documents can be obtained by calling the EPCRA Hotline at 1-800-535-0202.

Common Synonyms for Section 313 Chemicals. EPA 745-R-95-008. March 1995.

Compilation of Air Pollutant Emission Factors, 5th Edition, Volume I: Stationary Point and Area Sources **(AP-42)**. EPA 450-AP-425ED. 1995.

Consolidated List of Chemicals Subject to Reporting Under the Act (Title III List of Lists). EPA 550-B-96-015.

Estimating Releases and Waste Treatment Efficiencies for the Toxic Chemical Release Inventory Form. EPA 560/4-88-002. December 1987.

Estimating Releases of Mineral Acid Discharges Using pH Measurements. June 1991.

Interpretations of Waste Management Activities: Recycling, Combustion for Energy Recovery, Waste Stabilization and Release. April, 1997.

Protocol for Equipment Leak Emission Estimates. EPA 453/R-95-017. November 1995.

Toxic Chemical Release Inventory Questions and Answers, Revised 1990 Version. EPA 560/4/91-003.

World Wide Web Resources

Code of Federal Regulations, 40 CFR
www.epa.gov/epacfr40

CHEMDAT8/WATER8
www.epa.gov/ttn/chief/software.html#water8

Clearinghouse for Inventories and Emission Factors (CHIEF)
www.epa.gov/ttn/chief/

Compilation of Air Pollutant Emission Factors (AP-42)
www.epa.gov/ttn/chief/ap42etc.html

EPA homepage
www.epa.gov

Federal Registers
www.epa.gov/EPA-TRI

MSDSs (Note: A number of organizations maintain databases that contain MSDS information. The following is a short list of web sites with MSDS information.)
www.dehs.umn.edu/msds.html
www.nwfsc.noaa.gov/msds.html
www.chem.utah.edu/msds

SPECIATE
www.epa.gov/ttn/chief/software.html#speciate

TANKS
www.epa.gov/ttn/chief/tanks.html

TOXNET
www.nlm.nih.gov/pubs/factsheets/toxnetfs.html

TRI homepage
www.epa.gov/opptintr/tri